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A MONTHLY JOURNAL DEVOTED TO CLINICAL RADIOLOGY AND ALLIED SCIENCES



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# THE SURGICAL TREATMENT OF CANCER[1]

By WILLIAM J. MAYO, M.D., F.A.C.S., ROCHESTER, MINNESOTA

THE surgical treatment of cancer includes all the methods which have for their immediate or ultimate object the removal or destruction of the growth. The knife, radiotherapy, the actual cautery, and surgical diathermy are all well recognized forms of treatment. Each has a special field of usefulness, and can be used singly or in combination with other methods. To make a study of the comparative values of these methods of treating cancer necessitates a review of some of the conditions under which cancer develops and the protective reactions which Nature appears to employ in defence.

On the assumption that the cancer cell itself is the cause or at least the agent of the malignant process, it is interesting and profitable to ascertain, if possible, just what happens when the abnormal growth takes place.

All life depends on heat and energy resulting from oxidation, the union of oxygen with carbon, the ash of which is the carbon dioxid of respiration, and the union of oxygen with hydrogen, the ash of which is water. All foods contain in various proportions carbon, hydrogen, and oxygen; the relative value of foods in producing heat and energy is in proportion to the relation between the carbon and hydrogen and oxygen. For instance, carbohydrates (glucose $C_6H_{12}O_6$) and proteins, of somewhat similar molecular composition, oxidize readily because they have a high oxygen content. Besides these three elements the proteins contain nitrogen, which permits the deposition of form-giving elements, such as calcium and phosphorus and a little sulphur. The animal fats are all quite similar in composition. Tristearin, the most common, is composed of stearic acid ($C_{18}H_{36}O_2$) combined with glycerin ($C_3H_8O_3$). Owing to their higher carbon and hydrogen content, the fats on oxidation give two and one-half times as much heat and energy as the carbohydrates and proteins, but they burn slowly on account of the low oxygen content of the molecule.

The normal cell, in the process of oxidation, produces heat and energy just sufficient for its purposes. The fertilized ovum in the rapidity of its growth can be compared to a malignant neoplasm, but the growth of the ovum is orderly and with purpose, whereas the growth of the neoplasm is disorderly, without purpose, uncontrolled. It would appear, therefore, that uncontrolled oxidation of food, misused for the growth of cells without purpose, is the crime of the neoplastic cell.

That the cell itself is the active agent of cancer is shown by the fact that to develop metastasis, at least in the human body, the cancer cell must be actually transplanted. This argues that the cause of the disease is not extrinsic but intrinsic. If the cause were an external agent which gained access

[1]Read before the Radiological Society of North America, at Milwaukee, Wisconsin, December 1, 1926.

to the body, when the cancer metastasized, as, for example, from the stomach to the ovary or the liver, the newgrowth should be a malignant development of the type of cell of the invaded tissue. On the contrary, the newgrowth is composed of the same kind of cells as the original seat of the neoplasm.

This argument is weighty but not conclusive. A vivid imagination might suggest cross-fertilization of a pathologically disturbed cell by a foreign organism starting a process of cell division which would be carried out by the descendants of the cell, in any anatomic situation, without further fertilization, as long as nourishment could be obtained.

MacCarty has shown that malignancy is expressed morphologically by an excess of nucleolar material in the cell and by a deficiency in the normal differentiation in the cytoplasm of the cell. In other words, the more nearly the malignant cell approaches the normal, the less the malignancy; and the greater the nucleolar overgrowth, the greater the malignancy. This would seem to indicate that the oxidizing power which converts the blood into new cells resides in the nucleolus, and that the control, that is, the restraining influence which reduces oxidation to the exact amount needed for function, lies in the differentiated cytoplasm.

Thus, any agent which acts as a protoplasmic poison, through its deleterious effect on nucleolar tissue, has an inhibiting effect on the growth of malignant tumors. Colloid lead, colloid gold, arsenic, the Coley serum, and some other agents of this kind are known to have such effect.

The world is indebted to Kendall for a splendid piece of work in biochemistry which shows that oxidation in the body is influenced by an atom of sulphur in the molecule of the catalyst, as in glutathione and cystin. It is possible that a chemical phase of uncontrolled oxidation in cancer has to do with atomic sulphur. It is interesting in this connection that a highly sulphurized substance such as keratin, found in the form of hyalin, in a cancerous process indicates a reduction in malignancy.

The more cellular a cancer the more rapid the growth, and the greater the amount of the stroma about the cancer cell the slower the growth. One must look on the stroma, therefore, as a connective tissue defence by which Nature attempts to stem the advance of the disease. No doubt at times the contraction of the connective tissue stroma so compresses the malignant cells and so cuts off their blood supply as to effect a near-cure by natural processes. This defense is seen in the leather-bottle stomach, in which the cancerous growth progresses slowly for years. In such cases, after gastrectomy for the removal of the diseased tissue, it is sometimes necessary to cut thousands of sections for microscopic study before malignant cells are found.

At necropsy in cases of patients who have died from pulmonary metastasis, there are found not only large areas of carcinomatous tissue but also small areas, little knots of scar tissue, enclosing only a few cancer cells, and others of the same description containing no cancer cells. One may conclude that cancer cells had once been present in the negative areas but that a successful defense had been established by Nature's own powers.

Further, the rapid growth of cancer produces an embryonic cell which, as compared with the normal cell, has little power of resistance. Heat as low as 120° to 130° F. (Percy) may destroy these ill-protected cells without harming the normal tissues. The efficiency of the cautery in certain types of cases is thus explained. The heat not only destroys the delicate nucleolus of the cancer cell but also produces great quantities of scar tissue which, as it contracts, cuts off the blood supply of undestroyed cancer cells. The usefulness of the actual cautery has been recognized from the time

of Hippocrates, who, more than 2,000 years ago, uttered the aphorism: "Those diseases which medicines do not cure, iron (the knife?) cures; those which iron cannot cure, fire (cautery?) cures, and those which fire cannot cure are to be reckoned wholly incurable."

Surgical diathermy (electric coagulation) is simply another method of using heat. The electric current, starting innocuously from a large electrode and converging destructively at a limited focus, destroys from within outward, in contradistinction to the actual cautery, which destroys from without inward. For limited growths in certain regions of the body, for instance, the tongue, the cheek, the bladder and the rectum, and for small external growths, surgical diathermy has proved, in carefully selected cases, a reliable and satisfactory means of treatment, leaving a surprisingly small amount of scar tissue in the form of scars or strictures.

Excision with the cautery knife is often indicated for malignant growths of certain types, as Scott[2] has shown clinically, especially for the so-called inflammatory growths, and those with infiltrated or ill-defined margins. In these cases the knife has proved rather unsatisfactory because of the danger of transporting cells into vascular spaces, or of setting free infected venous thrombi and thus determining secondary involvement of the liver or the lungs. The cancer cell is too large to enter the capillary circulation and, under ordinary circumstances, is carried by phagocytes into the lymphatics. The failure of the lymphatic defense to destroy the cancer cells brought to these highways permits them to enter the general circulation through the thoracic duct and in this manner spread the disease.

The great value of the knife lies in its ability to remove not only the cancerous growth but also the regional lymphatics. Radiotherapy over the lymphatics has been used also to check or eradicate lymphatic extension, but such methods are makeshifts resorted to only when the knife is impracticable. It must be admitted, however, that when the lymph nodes are extensively involved the prospects of cure by any means are relatively small.

It would appear that radiotherapy to some extent is selective in its effect both on tissues and on persons. Different tissues in the same person react differently to radiotherapy, and patients with apparently the same degree of cancerous involvement may derive different results from the use of radium or X-rays. In one, radiotherapy will cause a complete disappearance or perhaps cure of the disease, in another only the most meager palliation may result.

There is great difference of opinion as to whether radiotherapy before and after every operation for cancer is desirable. At the present time we use radiotherapy before operation in only a small group of operable cases for a temporary sterilizing effect, especially if the growth appears to be unusually soft, in the hope of encapsulating it more firmly so that during removal fragments may not break off into the circulation. Again, we use radiotherapy after operation in those cases in which it is suspected that the growth has not been thoroughly removed.

In highly cellular growths radiotherapy—X-rays or radium, the choice depending on the situation and character of the growth—has a wide field of usefulness. When the intent is to secure a direct effect on a limited area, radium has many advantages, and for cancer in certain situations, for instance, the cervix uteri, radium at any stage, even early, gives apparently a prospect of cure equal to that of the knife at less risk. In the case of extensive cervical cancer, radium may cure where the knife would be essentially

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[2]A. C. Scott, Sr.: Glandular block dissections for metastatic cancer; report of one hundred and sixty cases done exclusively with the cautery. Jour. Am. Med. Assn., 1925, LXXXV, 1447-1451.

valueless. This is not true of cancer of the body of the uterus, in which total hysterectomy brings about cure in a very high percentage of cases at small risk. When wider areas must be affected, as in extensive peritoneal grafting from a cancer of ovarian origin, the X-ray, because it covers a wider area, is more beneficial.

The difficulty in evaluating radium and X-rays in the treatment of cancer lies in the fact that they are used so largely in treating cases of inoperable cancer or of metastatic cancer following operation, where the most that can be expected is palliation. The thoughtless give these agents little credit for what they actually accomplish, and often, disappointed that the impossible has not been accomplished, minimize their value.

At the present time, for cancers which have not extended beyond the immediate limit of the original growth and which, with the regional lymphatics, can be reached with a knife, surgical operation is the most satisfactory method of treatment. When a cancerous growth is extremely cellular or when there is extensive lymphatic involvement, surgical operation offers comparatively little prospect for permanent cure. In such cases an operation, to be followed by radiotherapy, should be only as radical as can be performed safely, that the danger of the operation may not exceed the probability of cure.

The proper treatment of cancer depends, therefore, on the combined efforts of the surgeon, the radiologist, and the pathologist in evolving methods adapted to each patient, rather than in adapting all patients to one method of treatment. Recent research would indicate that an immunologist should be added to this group.

A little-considered problem concerns the natural immunity to cancer which appears to protect 90 per cent of the population from developing the disease. Varying degrees of natural immunity must exist, for the development of cancer cannot be wholly the result of accidental circumstances.

One must recognize the disastrous effect of chronic irritation in the development of cancer. Does chronic irritation prematurely age the tissues, bringing about those senile conditions known to lead to cancer in the aged, or does it permit a foreign invader to enter the body through lesions in its protective covering and fertilize the cell?

Cancer has been considered as a disease expressed biologically as an animal reaction. There are some interesting data which appear to tie animal cancer in some of its aspects to plant life. Erwin F. Smith's splendid work on the parasitic origin of crown-gall cancer in plants has stimulated investigation of a possible relation of plant life to animal cancer.

The originator of a much-discussed cure for cancer has recently made public full particulars of the methods used in its production. He says that by means of a medium derived from plants an organism has been cultured from cancer in man which will in some instances reproduce the disease in experimental animals. He maintains, further, that a serum has been developed from animals immunized to these supposed cancer organisms which at times has value not only in the treatment of cancer in human beings but also in its prevention.

The work of Slye is of the greatest interest in the study of the prevention of cancer. She is able to breed at will mice that will not develop cancer under ordinary conditions, others that possess immunity under the most unfavorable conditions, even when painted with tar that has been previously activated by intense heat, and still others that are born with cancer as the result of ordinary physiologic wear and tear of intra-uterine life.

The work of Gye and Barnard, if confirmed by further experimentation, will greatly advance our knowledge of immunity to cancer. Gye developed from the fowl-sarcoma of Rous two complementary filtrates: Filtrate 1, a particulate body which

he believed to be a living organism, and Filtrate 2, a non-particulate body which he called the "specific factor." He believed that the first filtrate contained a foreign micro-organism and that the second was an activating fluid. If the two were injected together into fowls, cancer was produced, but if Filtrate 1 was injected without Filtrate 2, which we might call the soil-changer, cancer would not develop. Gye's second observation was that he could substitute for Filtrate 1 of the Rous tumor a virus obtained from true malignant newgrowths of the mouse, the rat, and of man, and that this substituted virus together with the specific factor, Filtrate 2, from the Rous tumor would produce sarcoma in the fowl. Other investigators have not been able to confirm Gye's work fully.

The experiments of Slye and of Gye at once focus attention on the problem of immunity, and logically lead to the idea of the prevention of cancer. Science has been able to develop soil-changers in smallpox, diphtheria, scarlet fever, tetanus, and many other diseases. Why not in cancer?

The evidence at hand makes one believe that the cancer research of the future will concern itself not only with the discovery of the cause of cancer, but also with what is of equal importance, immunology in relation to cancer, which will perhaps bring about better methods of treatment and, more important still, the prevention of cancer.

# ANGINA PECTORIS[1]

## WITH REPORT OF A CASE TREATED WITH ROENTGEN RAY

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IN a discussion of angina pectoris and the report of a case, it does not seem out of place to mention briefly the chief conceptions of this disease. Merely a casual reading of the literature will show how far afield many physicians have strayed in the diagnosis of angina pectoris. Leading students in medicine (1), (2), (3) feel it is time that such terms as "pseudo-angina" and "juvenile angina" were dropped out of medical literature. Unfortunately, many times the diagnosis is not clear-cut and one is tempted to conceal his ignorance by the use of such vague terms.

Heberden first wrote of this condition as a definite clinical entity (4). Allbutt (5) gives Heberden credit for a description of this disorder so comprehensive that little has been added to the clinical picture.

Heberden's historical description (6) of the disease places the pain in the region of the breast bone, and Allbutt (7) says, "We note that none of the classical physicians use the parrot-like and inaccurate word 'precordial.' They speak definitely of the pain as sternal or substernal." The radiation of the pain, especially to the left shoulder and arm, and the sense of impending death are carefully discussed in all articles on angina pectoris.

Mackenzie (8) shows, by drawings, areas in which pain is frequently felt in angina pectoris. These regions are those in which are distributed the sensory nerves which lie in close relationship to the cardiac nerves in the central nervous system. Speaking generally (9), the distribution is more commonly by the last one or two cervical and the first one or two thoracic segments. As to the character of the pain, nothing has been added to Seneca's description of his attacks (10). "The attack is very short and like a storm. I have undergone all bodily infirmities and dangers, but none appear to me more grievous; to have any other malady is only to be sick; to have this is to be dying." The angor or anguish of mind does not necessarily accompany the more intense attacks. There may be mild pain, with marked anguish, and, on the other hand, intense pain with little of the horror present. In angina pectoris the attacks are sudden, momentary, usually in the sternal region, occurring frequently while walking, especially after a heavy meal, and may be promptly relieved by nitroglycerin. Many exciting causes are mentioned, possibly the most frequent being walking against a strong wind. Levine (11) stresses the importance of determining a definite diagnosis in cases where the pain is mild, since it is so frequently true that such mild attacks may result in death in a few days, while those with severe pain and anguish may live a long time. Also, severe precordial pain may not be angina, which emphasizes the importance of a careful history and the serious consideration which must be given pain in the sternal region.

In April, 1916, Jonnesco (12), under a local anesthetic, resected the left great sympathetic from the base of the neck into the thorax, including the last two cervical ganglia and first thoracic ganglion. The patient had no further attacks of angina pectoris. This stimulated the surgical treatment of angina pectoris, and many variations in the treatment of this distressing condition have been tried.

In the selection of cases for sympathectomy, the diagnosis and condition of the

[1]Read before the District of Columbia Medical Society, October 20, 1926.

patient must be considered with the greatest care. Coronary thrombosis or embolism occurs much less frequently than angina pectoris, but it is accompanied by severe anginal pain in the majority of instances. It is perfectly evident, however cheerful we may feel as to the value of surgery in angina pectoris, that an operation should not be considered in coronary thrombosis. The literature recently has been full of reports of this latter condition. And Christian (13) felt so keenly the failure of the medical profession to appreciate this condition, that he said, in his opinion, that fourth-year medical students of to-day make this diagnosis where the referring physician had no idea what was the cause of the disability that led him to send the patient to the hospital. Possibly the surgical treatment of angina pectoris is responsible for the more recent appreciation of infarction. There is no doubt that some of the deaths following operation have been in cases of this nature. Surgery should not be attempted in coronary thrombosis, and the general treatment differs from that used in angina pectoris. The pain in coronary occlusion is more severe and more prolonged than in angina pectoris. It may last for hours, even longer, and at times is especially resistent to morphia. This is the "status anginosus" of the older writers. It is usually more circumscribed and in unusual situations, being very frequently referred to the epigastric region, and operations for suspected perforated ulcers and gall-bladder disease have been attempted where an infarction was the real factor present. There is often a spasm of the abdominal muscles and nausea and vomiting. The onset of pain in this condition is at times accompanied by symptoms of shock. Dyspnea is usually present. The knowledge of previous blood pressure readings is appreciated when, in coronary occlusion, a marked fall in blood pressure is a frequent finding. As Hamman (14) states, a systolic pressure of 130 mm. Hg. may mean nothing as an isolated observation, but it acquires far-reaching significance if previously it has regularly averaged over 200 mm. Hg. At times the blood pressure falls well below 100 mm. Hg. In angina pectoris there is always a rise of pressure during the attack. In thrombosis, the pulse becomes rapid with possible alteration in rhythm, while in angina there is practically no change. This last point has been frequently mentioned and is of great importance. Fever and leukocytosis are usually present in infarction, and a temperature rise may occur after a few hours. A pericardial friction is sometimes heard over an infarction, and, when heard, is of the greatest importance, but there seems to be a great difference of opinion about the frequency of this finding. The electrocardiogram frequently shows changes in the Q. R. S. group and in the T waves indicative of alterations in the heart muscle. Christian (15) says the diagnosis usually can be made without the aid of the electrocardiogram, and frequently it is impossible to have such aid. Also, it is possible in this condition to have a normal electrocardiogram.

It is interesting to note that Levine (16), in speaking of syphilis as an etiological factor, thinks this has been over-emphasized. In his study of eighty-one patients only six gave a positive Wassermann. However, in cases under forty-five the question of syphilis should be carefully investigated. Diabetes and gout are possible predisposing factors. Of course, arteriosclerosis is the most commonly associated condition. Auricular fibrillation is rare in angina. Mackenzie (17) goes into this rather fully, stating that in some instances of angina pectoris, auricular fibrillation has developed, followed by a disappearance of the angina, but there is a recurrence of the angina with improvement in the function of the myocardium and restoration of the fundamental rhythm. This observation has been repeated by a number of students of the circula-

tion. Willius (18), in a critical study of one hundred and fifty-five cases of angina, found only two cases of delayed conduction, one with complete block, and three with auricular fibrillation.

There are two important considerations before surgery should be attempted in angina pectoris (19): first, one ought to feel reasonably sure it will not be damaging; second, the patient selected should be one who may be expected to live long enough to benefit from any satisfactory results that may follow the operation. It is obvious that coronary thrombosis must be ruled out in the selection of cases for surgical treatment. Those presenting signs of myocardial decompensation and of syphilitic aortitis are unfavorable surgical risks. The congestive heart failure patient is the type of case in whom an angina may cease when failure sets in, and should not be operated on. The stability of the myocardium is the best gauge of suitable cases for surgery. The heart sounds should be of good character and especially should there be a good first heart sound. The rhythm should be normal, as a pulsus alternans, or gallop, are contra-indications for surgical treatment. The blood pressure may offer evidence of a coronary thrombosis, so, with a low pressure, this possibility must receive due consideration.

"We are as yet far from understanding the manner in which anginal pain is produced or the precise nerve channels involved." "Considerable research upon the structure and function of the cervical, sympathetic, and nervous pathways to and from the heart and aorta has to be completed before a surgical treatment can be devised with any degree of success" (20).

The leading theories as to the production of angina pectoris have been argued since Jenner's (21) coronary theory in the historical instance of John Hunter's illness, and the autopsy which showed coronary disease. This was the first mention of the coronaries as being a cause of angina pectoris. It is well known that sclerosis of the coronary arteries is found frequently in patients in whom no angina has occurred. Therefore, this theory does not explain all cases of angina. Claudication, or spasm of the artery interfering with the blood supply to the heart, has been used by those leaning toward the coronary theory to explain angina pectoris in those cases presenting no changes in the coronary arteries. This seems a very reasonable solution of this problem, but there is no real proof that claudication of the coronaries occurs.

Danielopolu (22) differs radically from Allbutt and others in that he feels angina pectoris cannot be produced by aortic distention. His theory has much in common with the coronary idea and claudication. He states in rather positive terms that, "The process is analogous to that concerned in the fatigue of voluntary muscle, inadequate blood supply, incompletely emptied resulting toxic substances. Consequent intoxication produces much fatigue, evidenced by sensory symptoms (fatigue and pain)."

Wenckebach (23) stimulated interest in Allbutt's theory that, in the very large majority of cases, angina pectoris is due to disease of the thoracic aorta. Allbutt (24) contends that there is irritation of the nerve end plates in the proximal aorta due to disease of the aorta and especially of its outer investment, wherein lie the sensory end organs that regulate blood pressure. Thus, factors producing greater stress in the first part of the aorta will give rise to pain, so long as the heart is equal to this increased task.

Mackenzie (25) feels that the subject is a matter for vague speculation still, but is inclined to the view that the pain of angina pectoris is associated with muscle contraction, and that a stimulus adequate to cause this pain is muscle contraction when there is a deficient blood supply to the heart muscle.

Reid (26) presents a solution of the problem consistent with Allbutt's theory. In the circulatory adaptation to exercise, there is dilatation of the peripheral stream bed, and this is brought about by the cooperation of the nervous system, probably by a reflex through the depressor nerve fibers of the vagus. He contends that this acts as a protective mechanism, as it permits the heart to contract without strain. A failure of this reflex dilatation of the peripheral arteries is suggested as the essential feature of angina pectoris.

François-Franck (27) demonstrated experimentally that a number of sensory fibers of the heart and aorta pass to the central nervous system by way of the cervical sympathetic and the vertebral nerve. Jonnesco (28) was so successful with his operation that various modifications of his method have been tried by many surgeons, with encouragement. The surgical treatment has met with opposition, Mackenzie (29) contending that a signal of great value may be taken from the patient, and feeling that pain is not a dangerous symptom.

The operation of cervical sympathectomy has been done many times, and, with care in the selection of cases, it may be attempted without apparent danger to the patient. The surgeon, of course, does not expect to change the conditions underlying the angina, and insofar as the pain constitutes a valuable warning, there are many cases reported where patients are living in a far more comfortable condition than prior to operation. Many who still hesitate to advise surgery are suggesting that where the pain is intolerable the operation is justifiable, as frequently patients are relieved of this most distressing symptom. The one grave drawback would seem to be our lack of knowledge of the nervous pathways. But results obtained by the various surgical procedures are most encouraging and they have stimulated interest in searching for the causes of angina, and more knowledge will determine the best procedure in the treatment.

The treatment of the case reported was proposed by Dr. Hamman, of Baltimore, whose idea was inspired by the results obtained in roentgen-ray therapy (30) in cases of thrombo-angiitis obliterans. A suggestion that such treatment might be used in angina pectoris appeared in a recent article by Beall and Jagoda (31), who were reporting results following the use of roentgen ray in thrombo-angiitis obliterans and Raynaud's disease.

The following case report is the reason for this presentation.

G. T., a consulting mining engineer, married, aged 48, was first seen June 10, 1924, complaining of slight pain in the lower end of the breast bone, "with flatulence."

*Past history.*—The patient has always been healthy and has led a very full, busy life. His habits have been good and there has been no history of venereal infection. His work requires many trips into the coal regions, with examination of mines. He served in the World War, being overseas for nine months. After the Armistice he made a survey of the mine regions of France and Belgium.

*Present illness.*—Two days prior to this first visit in June, 1924, he had noticed a slight pain in the lower sternal region after dinner, when walking rapidly. This was associated with flatulence, and the expulsion of gas relieved him. But the fact that exertion seemed to bring it on resulted in his seeking advice.

*Examination.*—Outside of the following findings, the examination was essentially negative. The spine was lordotic, with quite a marked dorsal scoliosis; a funnel breast, probably rachitic in origin. The apex beat was in the fifth interspace, 8 cm. to the left of the median line. It was faintly palpable, and was well within the nipple line. Dullness to the right could not be made out. There was no impairment over the manu-

brium, and no episternal pulsation. At the apex the heart sounds were of good character. The rhythm was regular and the rate was 80. The aortic second sound was accentuated. No murmurs were heard. The radials, brachials, and temporal arteries were palpable. The dorsalis pedis was palpable. There seemed to be increased thickening in these vessels. The blood pressure was 170/100 mm. Hg.

A roentgen-ray study showed the stomach and duodenal cap normal in all respects. The heart and great vessels appeared normal. The measurements were: midline right 3.7 cm.; midline left 7 cm.; total 10.7 cm. The transverse diameter of the chest was 24.5 cm. The great vessel area was 5.7 cm. The electrocardiogram was normal. The urine was negative, and the renal function was 62 per cent. The Wassermann was negative.

The patient was advised as to care in overworking, and had some dental work done. He was not seen until October 24, 1924, when he had a rather severe pain under the upper part of the sternum following exertion. This pain, while of short duration, was transmitted into the left arm, and was accompanied by considerable apprehension. His blood pressure was 180/100 mm. Hg. With rest in bed for two days it fell to 140/90 mm. Hg. and he felt as well as ever. From this date he carried nitroglycerin, which promptly relieved attacks of pain. These attacks were all initiated by effort or emotion. In October, 1925, pain was more frequent and accompanied by angor of marked degree. Dr. Hamman saw the patient with me November 19, 1925, and as a sympathectomy was not acceptable because the patient's wife was not well, roentgen ray was suggested.

Dr. E. A. Merritt gave his first treatment November 25, 1925, the rays being applied to the lower cervical and upper five dorsal region. The dose was 5 milliamperes with a 9-inch gap at 10-inch distance through 5 millimeters of aluminum for 6 minutes. This was a sub-erythema dose. This treatment has been repeated twelve times up to this date, October 15, 1926. The intervals of treatment have varied from ten days to four weeks.

The patient informs me—on October 15, 1926—that he is incomparably better. He still has substernal pain after exertion or emotion, but there is no transmission into the arm, and the attacks are promptly relieved by nitroglycerin. The pain is decidedly less severe, much less frequent, and is not accompanied by angor. He states very positively that since the last week of December, 1925, he has been able to do more work than ever before.

These opinions were based upon a carefully kept diary of the patient, who has an intelligent comprehension of the theories of angina pectoris. His observations show that for about ten days following treatments he has been free from attacks. He would return for treatment when he expected to be specially busy or was apprehensive.

No conclusion can be drawn as this is only one case, but the result of the treatment is so encouraging that I felt it should be reported.

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# CONCLUSIONS REGARDING TECHNIC FOLLOWING ONE THOUSAND INTRATRACHEAL INJECTIONS OF IODIZED OIL IN ADULTS[1]

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A NUMBER of methods have been used to inject iodized oil into the bronchial tree, among which are the transglottic, subglottic, bronchoscopic and supraglottic.

The *transglottic* method (Fig. 1) consists in passing the tip of the cannula through

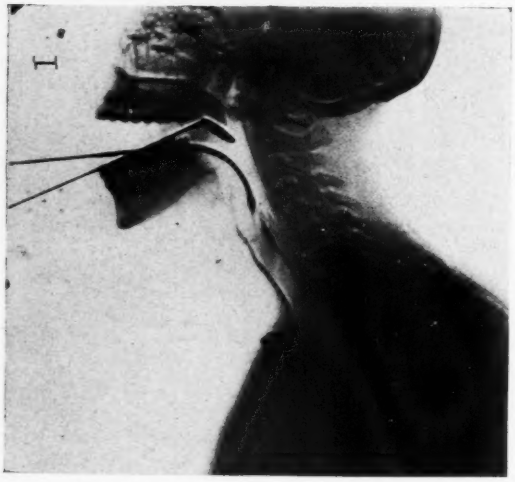

Fig. 1. Transglottic position of cannula.

the glottis into the trachea after anesthetizing the pharynx and larynx with 5 per cent cocaine or butyn solution.

The *subglottic* method, designed by Rosenthal and employed by Forestier, is carried out by passing a hollow curved needle attached to a metal guard (Fig. 2) through the cricothyroid membrane into the lumen of the trachea after anesthetizing the skin and subcutaneous tissues. The true position of the needle can be ascertained by attaching a syringe, and aspirating. The presence of air or mucus is proof that it is in the trachea. Intratracheal anesthesia may be procured by injecting 2 c.c. of warmed 5 per cent cocaine or butyn solution into the larynx.

The *bronchoscopic* procedure includes the injection of iodized oil into the bronchial tree with the aid of a bronchoscope.

The *supraglottic* method (Fig. 3) consists simply of allowing the warmed oil to flow through the open glottis into the trachea. The cannula does not enter the larynx.

Fig. 2. Curved hollow needle with guard attached to syringe by short rubber tubing as used in subglottic method.

[1]Read before the Radiological Society of North America, at the Annual Meeting, Milwaukee, Nov. 29-Dec. 4, 1926.

### CHOICE OF METHODS

Each has some particular advantage. For example, the *bronchoscopic* permits prompt recognition of the diseased area and the aspiration of exudate for cultural purposes. The *subglottic* avoids any interference with the pharynx and larynx and in the case of children this method is generally used, particularly by the French school. The writers have employed the *supraglottic* method except in their earlier work of 1924. This paper is based on the experience derived from a series of one thousand consecutive injections by the *supraglottic* method. We feel that this method is best in the majority of adult cases for the following reasons:

(1) The supraglottic method is more simple than the others.

(2) Time is saved in this operation.

(3) The patient is subject to less strain and worry.

(4) This method does not require the services of a trained specialist, such as the otolaryngologist or surgeon, and the radiologist and internist can readily acquire the necessary technic.

(5) The supraglottic way is more economical from the standpoint of time, expense and labor.

(6) This method may be employed in the fluoroscopic room, hospital, or office with less inconvenience to the patient and physician.

(7) Less anesthesia is required in the majority of cases.

(8) Few, if any, dangers are encountered.

(9) No inconvenience is experienced by the patient after the iodized oil has been injected, such as soreness of the throat or tenderness of the skin and subcutaneous tissue over the trachea (subglottic).

(10) Any part of the bronchial tree can be visualized by this method in most instances.

We feel that the *supraglottic* method is a desirable one to use if visualization of the bronchial tree is to be universally employed.

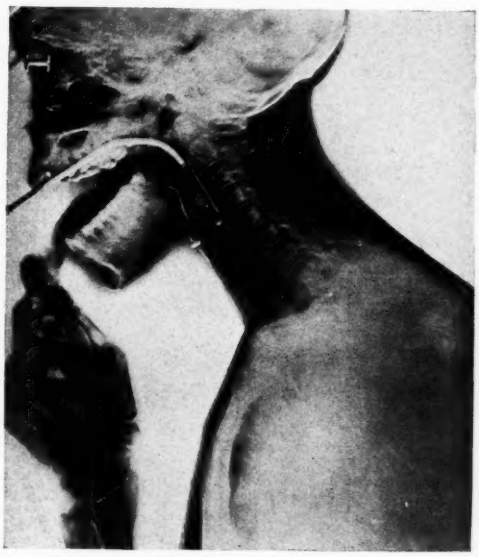

Fig. 3. Showing supraglottic method, the correct pharyngeal position of the cannula and the iodized oil falling on the upturned surface of the epiglottis.

### PROCEDURE

The following points should be noted in the employment of the *supraglottic* method:

(1) Always inform the patient as to what you are attempting to do and make him realize that his co-operation is essential to the success of the injection. State definitely that no operation is to be performed, no incision made, and no pain caused. Instruct the patient that it is imperative for him to refrain from coughing and swallowing. Complete relaxation of the patient is necessary. Psychic anesthesia is needed but is more difficult to secure in the presence of onlookers.

(2) The anesthetic solutions and oil should be warmed to prevent reflex cough and to facilitate the easy and rapid flow of oil over the mucous membrane of the larynx and trachea.

Fig. 4. Small metal syringe with cannula attached, used for laryngeal anesthesia.

Fig. 5. Thirty c.c. metal syringe and cannula, used for injection of iodized oil.

(3) The pharynx and larynx should be sprayed with a 5 per cent cocaine or butyn solution—taking pains that the epiglottis, uvula and posterior walls of the pharynx are covered. Two c.c. of a 5 per cent cocaine or butyn solution may be injected into the trachea by the use of a small syringe (Fig. 4) while the patient is instructed to inspire through the mouth. This opens the glottis and the anesthetic will find its way down the larynx. The use of a laryngeal mirror is not necessary for laryngeal anesthesia or the injection of oil except in a few instances. The pharynx should be illuminated by a headlight.

(4) In two or three minutes the patient should feel a lump in the throat. The oil can now be injected. Twenty c.c. of warm oil should be ready in a special metal syringe (Fig. 5). The tongue should now be drawn well forward, as shown in Figure 6. In so doing the glottis is opened, the esophagus closed and the pharyngeal muscles have formed a funnel which allows the contents to drain into the larynx while the patient is breathing through the mouth (Mendel).[2] By slight but constant pressure on the piston the oil is projected against the under surface of the epiglottis while the patient breathes deeply and quietly through the mouth. Oil causes little or no irritation to the laryngeal mucous membrane, the re-

2The Lancet, July 14, 1906.

verse being true when water or other fluids are injected.

(5) At this juncture, again instruct the patient to refrain from coughing or swallowing. A tendency to cough may be overcome by the patient breathing more deeply while the operator pulls the tongue out and at the same time lessens the pressure on the syringe piston.

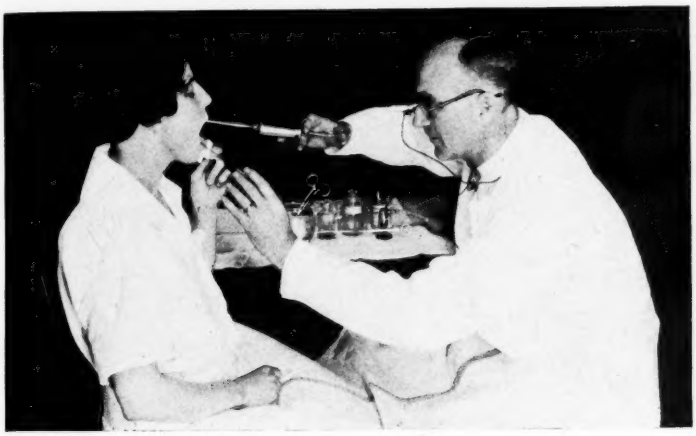

Fig. 6. Showing patient in the upright position which is employed when lower bronchial tree is to be visualized.

(6) Some cases may be injected without anesthesia and in the majority of cases a laryngeal mirror is unnecessary. The curved cannula should not touch any part of the pharynx (Fig. 7). The tip must not touch the epiglottis but should be placed in such a position that the flow of oil will impinge upon its under surface (Fig. 3).

(The fewer instruments used, the less paraphernalia seen, the quieter the surroundings, the more easily is this method accomplished.)

(7) There has been some question as to the necessity of bronchoscopic aspiration of bronchiectatic cavities before their injection with oil. We have found that these cavities are apparently equally well filled whether the oil is injected before or after they are emptied. The high specific gravity of the oil (1350) enables it to displace the bronchiectatic contents (secretions). This is practically demonstrated by the fact that when the injected oil has reached a main bronchus and the patient coughs it is seldom that iodized oil is contained in the expectoration. On the other hand, much pus and mucus is evacuated by coughing while the oil remains in the bronchial tree. In cases where it is desired that the bronchi be promptly emptied of retained secretions, an intratracheal injection of 4 c.c. of a hydrocarbon oil preparation containing 1 per cent menthol will stimulate the bronchi and the patient will then expectorate the pent-up contents.

(8) *Quantity of oil necessary.*—From 15 to 20 c.c. is usually enough for one injection. This will generally visualize a goodly portion of the lung field (Fig. 8). Gravity and aspiration are the forces which bring the oil to the terminal branches. Thirty to forty c.c. may be given if a more extensive field is to be investigated.

(9) *Position of the patient.*—This depends on what particular part of the lung field the operator desires to visualize. As the great majority of cases requiring lung field visualization are suffering from some

affection in the lower part of either lung, the upright position as seen in Figure 6 is the one more frequently used. If the lower right lung is under suspicion, the patient is

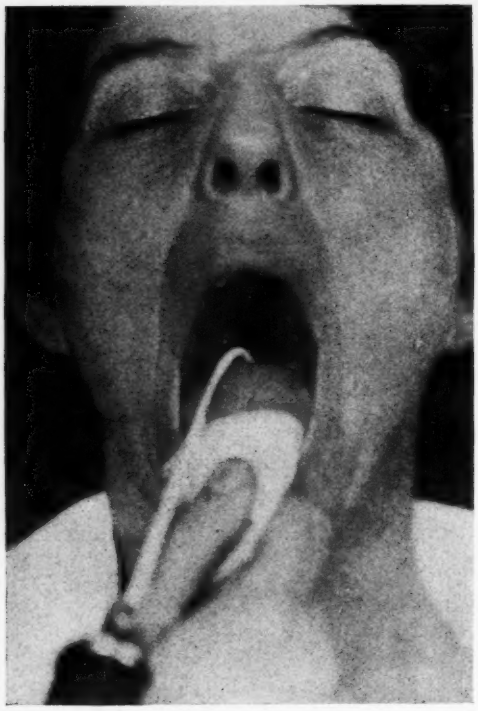

Fig. 7. Position of the cannula in mouth, avoiding surrounding parts.

instructed to lean slightly forward towards the right side, still keeping the head in a vertical position. The reverse is true when the left pulmonary base is to be visualized. If the middle or upper lung fields are to be studied, place the patient on a tilting table in the recumbent position, lying on the affected side. The head is elevated by pillows and turned upwards, as seen in Figure 9. Anesthetize and inject as in upright position. Immediately after injection, tilt the table so that the patient's head and thorax are pointing downwards at an angle of 45 degrees (Fig. 10). Let the patient retain

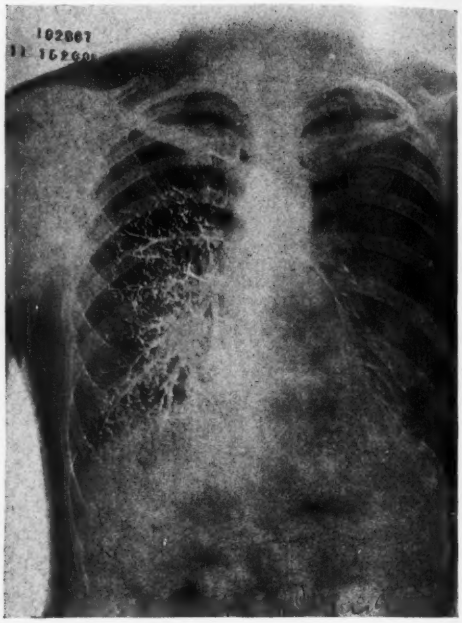

Fig. 8. Showing the extent of visualization induced by the injection of 20 c.c. of iodized oil.

this position for at least three minutes so as to visualize the upper lung fields, as seen in Figure 8.

(10) *Choice of lung fields.*—Ascertain from the patient where he or she thinks the symptoms such as sputum, wheezing, pain or sensation after coughing originate. The patient will often state that the sputum is increased when a certain position is taken. Cough may be elicited or increased by change of position. A patient giving the history of chronic bronchitis may show moisture in the form of râles at the base of the right lung. This sign could be taken as evidence of some disturbance in this particular locality. Definite basal densities seen on the X-ray may decide the choice of locality. Many cases show no differentiating sign either from the clinical history, physical examination or radiological study. In such cases both lower lungs should be injected. It is preferable to wait twenty-four hours before giving the second injection.

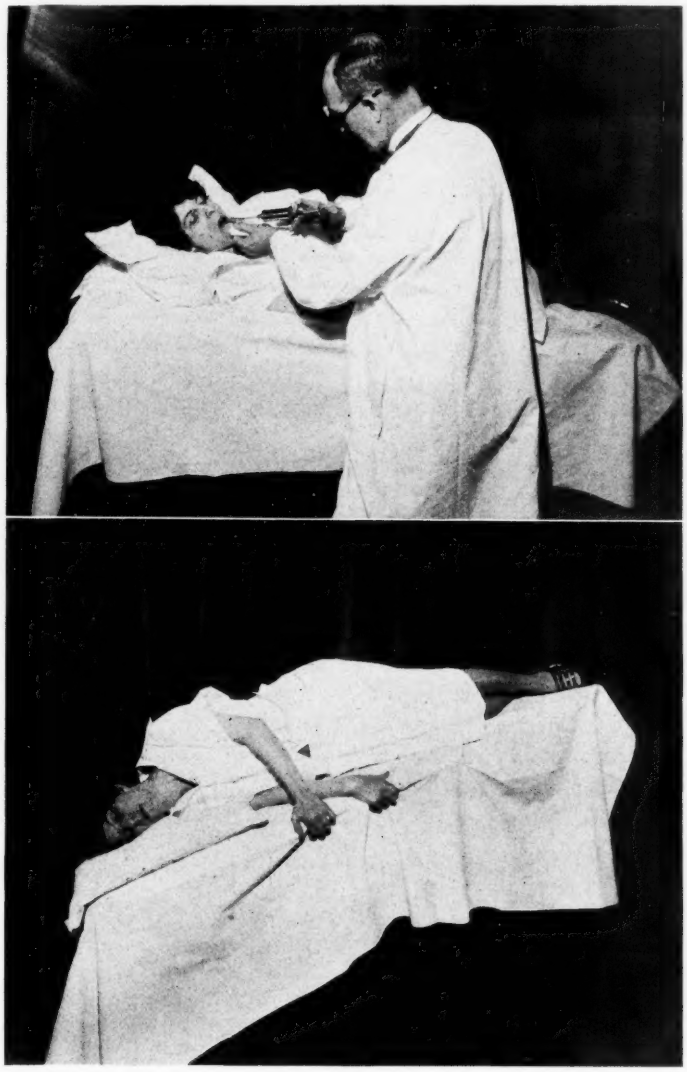

Fig. 9 (above). Showing position of patient during injection of oil when right, middle and upper lung fields are to be visualized.
Fig. 10 (below). Showing position of patient immediately after the reception of the oil, as in Figure 8. This position facilitates the flow of oil into the upper and middle bronchial branches.

SOME INDICATIONS FOR THE BRONCHIAL INJECTION OF IODIZED OIL

(1) Cases of chronic cough associated with long-standing infection in the upper respiratory tract, particularly sinusitis.

(2) Cases of cough with purulent expectoration giving the history of a previous pneumonia or the inspiration of an organic foreign body.

(3) Cases of long-standing cough with little, if any, expectoration in the absence of frank pulmonary disease.

(4) Obvious cases of bronchiectasis for the purpose of mapping the diseased area.

(5) Cases of bronchial fistulæ.

(6) As a therapeutic agent.

### POSSIBLE COMPLICATIONS

(1) The swallowing of the oil during the operation. Iodized oil is a chemical compound which disintegrates and liberates metallic iodine when acted upon by intestinal alkaline secretions. If the patient has swallowed any considerable amount of oil (fluoroscopic observation), a glass of hot water containing a dram of soda bicarbonate will often act as an emetic and prevent the oil from entering the intestinal tract. A dose of castor oil will expel the compound before there is time for disintegration and absorption.

(2) In our series of a thousand cases we have experienced six instances in which some slight untoward effects followed the injection of the oil. In these six cases a mild iodism occurred in the form of an irritable rash developing about forty-eight hours after the administration of the oil. In a short time these symptoms disappeared, the patient experiencing no further inconvenience. We believe that this iodism was the result of unacknowledged or unnoticed oil in the gastro-intestinal tract and was not due to absorption from the bronchi. In a few instances a slight fever developed for a few days following the initial injection. In this series we have experienced no accidents, no cases of aspiration pneumonia and no undesirable sequelæ in any case other than the instances above mentioned.

### CONTRA-INDICATIONS

(1) Acute affections such as occur in the early stages of cold and influenza.

(2) Acute active tuberculosis.

(3) Very extensive and advanced pulmonary suppurations, particularly when the patient is extremely weak.

(4) Advanced circulatory complications such as angina pectoris, aneurysm and cardiac decompensation.

(5) Recent hemoptysis.[3]

3 Discussions of papers presented at the Annual Meeting of the Society will be published in an early issue of RADIOLOGY.

# DUODENAL ULCER: A COMPARISON OF THE ROENTGENOLOGIC AND HISTOLOGIC FINDINGS[1]

By CHARLES G. SUTHERLAND, M.B. (Tor.), Section on Roentgenology, Mayo Clinic, ROCHESTER, MINNESOTA

THE statement that no other organ in the human body has been accused of so many disorders which it never had as has the stomach is well borne out in a study of the records in the Mayo Clinic over a period of five years. During this time 19.6 per cent of the total number of patients registered were referred for the roentgenologic examination of stomach and duodenum. Most of these patients had had symptoms of gastric disorder at one time or another that suggested this examination. That many of the symptoms were reflex and secondary to trouble situated in some other organ is apparent from the fact that in approximately 70 per cent of all the examinations made the roentgenologic data were negative. On analyzing the non-surgical cases of one year it is found that among those in which the roentgenologic data were negative, the clinical diagnosis was functional disorder in 56 per cent, reflex disturbance from disease of the gall bladder or biliary tract in 13 per cent, and reflex from disease of the appendix in 3 per cent, while in the remainder it was secondary to a wide variety of conditions, including pulmonary tuberculosis, and gastric and abdominal crises associated with syphilitic and non-syphilitic lesions of the central nervous system. In another series of cases (surgical) in which the result of the roentgenologic examination was negative, the findings at operation were disease of the gall bladder or biliary tract in 55 per cent, and lesions of the appendix or intestinal tract in 34 per cent. In many cases these were co-existent, but in each the predominant lesion was considered as the factor in the gastric disturbance.

Duodenal ulcer, in the experience at the Clinic, is the most common of all lesions seen roentgenologically in the alimentary tract. As determined by the roentgen ray, duodenal ulcer occurs more than nine times as often as gastric ulcer, and more than four times as often as gastric carcinoma.

The difficulty of differentiating clinically duodenal ulcer, cholecystic disease, and appendicitis in some cases is well known to all diagnosticians of wide experience; comparison of clinical and surgical notes in any large series of cases will occasionally reveal duodenal ulcer when there is a definite clinical picture of cholecystic disease, or cholecystic disease when the clinical notes were all suggestive of duodenal ulcer. Again, a routine examination of the abdominal organs in all cases at the time of operation not infrequently reveals the co-existence of any two, or all three, of these lesions in the same patient. An appreciation of these difficulties must stimulate the roentgenologist to use every method that will enhance the value of the roentgenologic diagnosis.

A brief survey of the history of duodenal ulcer reveals interesting points. According to Robertson and Hargis, while casual mention of this disease-entity was made by de Muralto in 1688, careful scanning of the literature failed to reveal any comprehensive study of the subject prior to the work of Krauss in 1865; and even as late as 1923 the incidence of gastric ulcer was reported as at least twice that of duodenal ulcer. In 1924 the necropsy records of the Mayo Clinic showed 147 gastric to 237 duodenal ulcers.

In the older textbooks one finds mention of gastric and peptic ulcer, but little reference to duodenal ulcer. In later volumes,

[1]Presented at the Annual Meeting of the Radiological Society of North America, at Milwaukee, Wisconsin, November 29 to December 4, inclusive, 1926.

particularly those published prior to the full development of roentgenoscopy of the stomach and duodenum, the differential diagnosis of gastric and duodenal ulcer was considered entirely possible; now it is an accepted fact that there is no symptom or group of symptoms that always warrant a definite diagnosis of one or the other type of ulcer. These facts are explained, in part, by the progress in the roentgenologic diagnosis of duodenal ulcer. Until 1914, when Cole drew attention to bulbar deformity, the diagnosis of duodenal ulcer was based on varying combinations of indirect roentgenologic signs with the clinical manifestations. Even after the direct method of diagnosis was established, acceptance of this sign was difficult because of the discordance between the roentgenologic appearance of the deformity and that at operation. Only after painstaking recording of the roentgenologic data and their comparison with those at the operating table had explained the discrepancies, and following a complete divorce of the roentgenologic signs from the clinical by the roentgenologist, did the roentgenologic diagnosis of duodenal ulcer attain its present high plane of accuracy.

The pathognomonic roentgenoscopic sign of duodenal ulcer is the incisura, which deforms the normal contour of the bulb; this may be unilateral or bilateral and may vary in size from a mere slit on the lesser or greater curvature, to an indentation of both contours that nearly bisects the cap. All manner of variations of this deformity may be seen. The incisura occurs in the plane of the ulcer and, because more than 95 per cent of duodenal ulcers occur within the first 3 cm. of the duodenum, is usually seen nearer the base, or pyloric end, of the bulb. A correlation of the roentgenologic with the histologic data aids materially in determining the parts played by organic lesions and by spasm in the production of this deformity. Robertson and Hargis from their study of necropsy material reported significant observations. They suggested that many ulcers evidently healed of their own accord, as was shown by the number of scars found by careful search during routine postmortem examinations. This characteristic of rapidly healing lesions with the formation of cobweb-like cicatrices was also noted in the experimental production of duodenal ulcer. A shortening of the distance from the pylorus to the papilla of Vater, from the normal measurement of 7.9 cm. to 6.5 or 6 cm., was not uncommon. Pouching of the first part of the duodenum, due to contraction and puckering of the gut, was frequently noted. With ulcers on the anterior or posterior surface, the pouching was generally bilateral and situated immediately below the pylorus. With ulcers on the antero-lateral surface, the pouching was generally unilateral and often quite extensive. These pouchings have erroneously been called diverticula; the majority of congenital diverticula occur near the entrance of the papilla of Vater and they are uncommon in the first 3 cm. of the duodenum. There is no doubt that small collections of contrast medium caught in these pouchings have been misinterpreted as niches. Roentgenoscopic examination with approximation of the anterior and posterior walls of the duodenum, best carried out with the patient in the right oblique position, that is, with the right shoulder toward the fluoroscopic screen, will obviate these errors. Diverticula and ulcer niches will persist during successive examinations, while the pouches can be emptied by manipulatory palpation.

Study of necropsy material also revealed other deformities fully as significant from the standpoint of perverted function. The most common of these is an exaggeration of the normal curve in the first two portions of the duodenum. The viscus is drawn backward and to the right, in close apposition to the liver, occasionally bound firmly to the neck of the gall bladder and more or less completely immobilized through the first

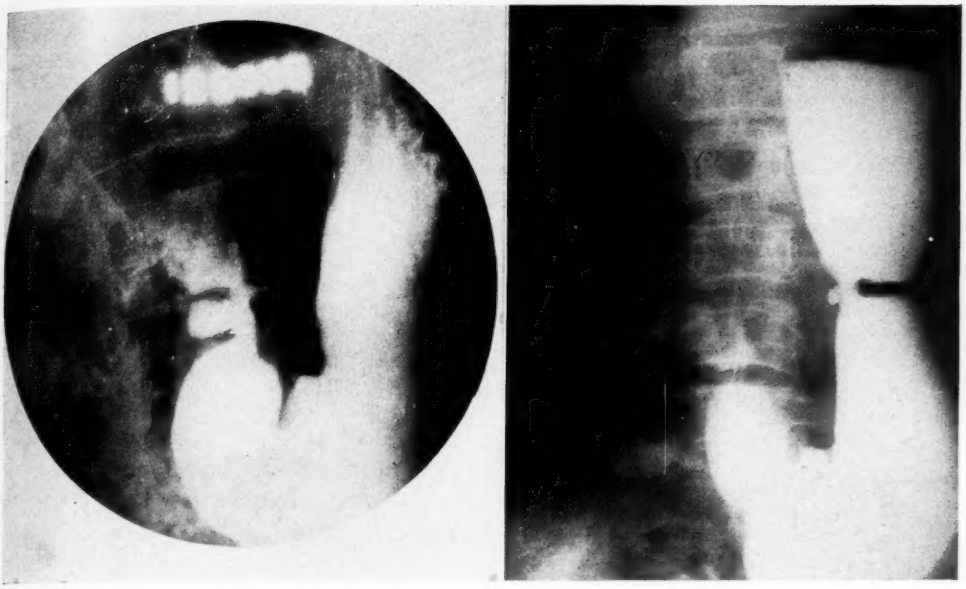

Fig. 1. Duodenal ulcer, with niche and incisura, on the left; opposite is a gastric ulcer showing a similar type of deformity. The hour-glass deformity will not be demonstrable at operation when the patient is anesthetized.

half. At the same time the shortening and distortion dislocate the normal relations of the head of the pancreas, by which the first portion of the duodenum and often the pyloric portion of the stomach are brought into firm anatomic union with it. The excessive connective tissue often formed on the outer surface of the duodenum opposite the ulcer becomes attached to the pancreas, gastrohepatic omentum and capsule of the liver, thus exaggerating the deformities already indicated. Lastly, there is the anatomic narrowing of the pyloric ring. Such narrowing is independent of any spastic phenomena, and is produced when the margin of the ulcer encroaches on the musculature of the sphincter.

The counterparts of these pathologic data are seen by the careful observer in the roentgenoscopic image. Attention is frequently called to duodenal ulcer by excentric emptying of the contrast medium through the pyloric opening. This may or may not be prefaced by delay or difficulty in the filling of the cap. Frequently there is broadening of the pyloric end of the stomach; in some cases this may be due to a layer of secretion held at the pylorus, in others to a definite stenosis of the pyloric muscle, or it can occur from voluntary muscular effort, so that perfect relaxation of the patient must be obtained. Instruction is given to droop the shoulders slightly, relax the abdominal muscles and breathe quietly with the mouth open, or distraction by conversation may suffice, or it may be necessary to have the patient sit down with the elbows resting on the knees for five or ten minutes. If the patient is stout and of the hypersthenic type it is frequently difficult to distend the duodenal bulb, the stomach is carried high, and the angulation of the first and second portions of the duodenum is acute. In such cases the bulb can usually be located only by turning the patient to an exaggerated right oblique position; it is generally impossible to see the bulb in the ordinary left oblique position because of the overlapping

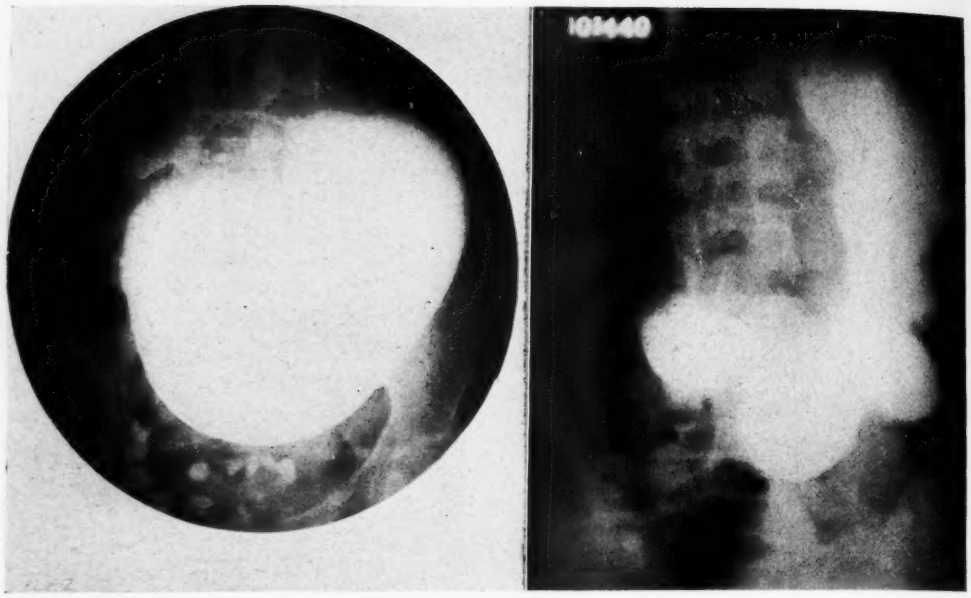

Fig. 2. Hypotonic stomach on the left, hypertonic stomach on the right. In the roentgenogram the former is apparent with the prepyloric haziness due to secretion; if the patient is in the recumbent position for a short time the hyperperistalsis develops.

of the shadow of the stomach. By having the patient place the right hand over the left shoulder, carry the elbow high, bring the left arm forward, and turn toward the right into the lateral position or slightly beyond, the bulbar shadow is projected toward the examiner's right and an excellent view of it is afforded. Because of the difficulty of reproducing this position it is advantageous to substitute a cassette for the screen and make films at the time, as is done in some of the European clinics.

Anatomic narrowing of the pyloric ring is frequently associated with retention of secretion in, and marked dilatation of, the stomach. The contrast medium is seen to fall in masses and collect in a thick layer in the most dependent portion of the stomach. Time and effort may be conserved by placing the patient in the prone position for from five to fifteen minutes, in which period the barium will usually reach the pyloric end of the stomach and will be seen to pass in a fine stream through the greatly narrowed duodenal bulb. If peristalsis can be followed to the pyloric end and the stomach appears to be free from any filling defect or deformity, one can with considerable assurance make the diagnosis of duodenal ulcer. Retention and hyperperistalsis and absence of deformity or defect of the pylorus are pathognomonic of duodenal ulcer.

MacCarty has reported some interesting observations from a study of duodenal ulcers and chronically inflamed portions of the duodenum (duodenitis) excised by the surgeon. He has found that duodenal ulcers are shallower and have less scar tissue than gastric ulcers; that the mucosa of their border is usually approximately the same thickness as normal duodenal mucosa and does not project over the crater, and that there are no cytologic changes in duodenal tubules which suggest that carcinoma develops in them. He notes that all coats of the organic wall may be excavated in duodenal ulcers and gastric ulcers alike.

The surgeon has two criteria by which he

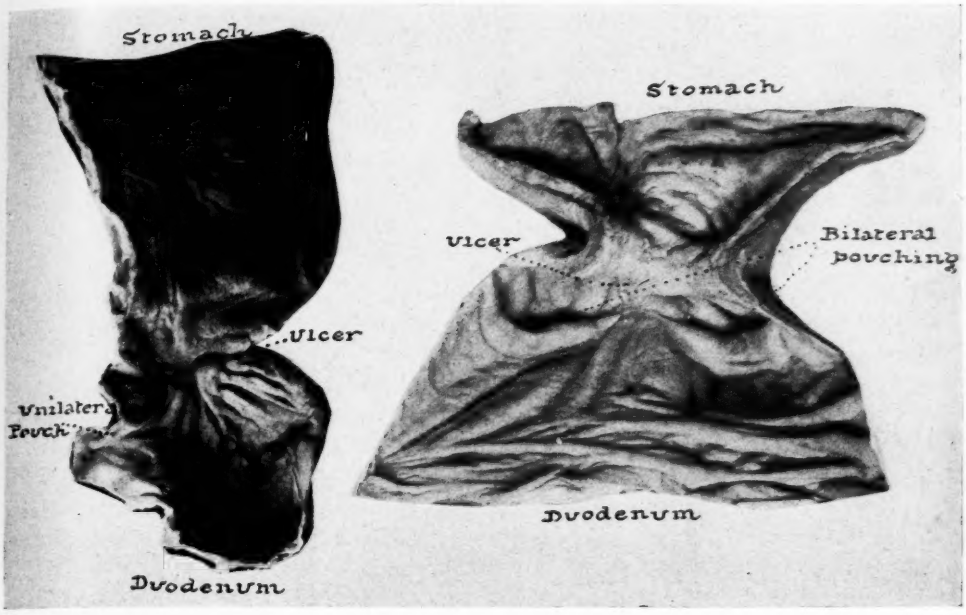


Fig. 3. Unilateral and bilateral pouchings seen in necropsy specimens. Collections of contrast mediums in these pouchings will simulate niches of ulcer and diverticula and can be differentiated only by palpatory manipulation.

may recognize duodenal ulcer: (1) the presence of a scar, with or without an accompanying inflammatory exudate, and (2), in the absence of a definite scar, stippling of the serosa. The latter has a reversed strawberry-like appearance created by handling or lightly brushing the serosa overlying the bulb with a gauze sponge, and is due to the rupture of minute capillaries. Rarely, in the absence of these signs, but with definite clinical or roentgenologic evidence of duodenal ulcer, the surgeon may have to open the duodenum to prove the presence or absence of an ulcer.

While the histologic findings of the various observers quoted would seem to present sufficient evidence to substantiate the opinion that the deformities seen in duodenal ulcer have an organic basis, observations at the operating table would suggest that there are still some unexplained factors. For example, lesions are seen which exhibit definite and sometimes quite extensive deformities on the screen and in the roentgenogram that are not discernible by the surgeon on mere inspection or palpation, and that become apparent only through the phenomenon of stippling just mentioned. These have their counterpart in the incisura seen on the greater curvature of the stomach opposite an ulcer, or the prepyloric spasm frequently associated with ulcers on the lesser curvature. Gray suggests that this may be due to a derangement of the normal neuromuscular mechanism of the stomach which results in an increased vagus excitation and diminution of the sympathetic control. A good example of this is seen in duodenitis, a lesion which produces definite deformities in the duodenal bulb. MacCarty says that the inflammatory reactions in duodenitis do not differ from those in other portions of the gastro-intestinal tract seen in a fresh condition. There are cellular destruction, congestion, edema and migration of leukocytes, lymphocytes and endothelial leukocytes. Lesions are localized or diffuse; when diffuse the appearance of the organ at ex-

ploration is not readily confounded with duodenal ulcer; but when localized, the external appearance of the serosa is indistinguishable from that associated with small ulcers.

The other diagnostic sign of duodenal ulcer is the niche. This has been seen without any appreciable deformity of the duodenal bulb, although it is commonly associated with such deformity.

In a comparison of the excised specimens with the extent of the deformities exhibited in the roentgenogram, the disparity between the gross and roentgenologic data was striking. The deformities apparently had no parallel in the extent and size of the pathologic processes. Minute ulcers were attended with extensive deformities on the screen and in the roentgenograms, while much larger ulcers showed little or no deformity of the duodenal bulb, and were detected only by observation of the barium-filled crater of the ulcer on approximation of the anterior and posterior walls by manual palpation.

Two other facts are outstanding: the extensive deformities observed by the roentgenologist at his examination are seldom observed at the operating table when the patient is under the anesthetic, and deformity of the bulb often persists in patients who have had relief from all symptoms under treatment, even in those who have been relieved by gastro-enterostomy. The dictum of "once a duodenal ulcer always a duodenal ulcer" among roentgenologists is one of the known limitations of the roentgenologic method in the diagnosis of duodenal ulcer in subsequent examinations.

One must conclude, therefore, that there are two factors in the production of the deformity in duodenal ulcer: the mechanical factor of over-distention of a thin-walled tube producing distortion of the normal contour in places where there is inflammatory thickening, edema, multiple small cicatrices of healed ulcers and attachments to adjacent structures from excessive connective tissue formation, which alter the normal relations of the viscus; and derangement of the normal neuromuscular mechanism by ulceration of the mucous and muscular layers with resultant irritation. Microscopic study of the ulcers has demonstrated definite breaks in the continuity of the muscular layers but whether these are a fundamental or merely a contributing factor has not been fully determined.

In conclusion I want to stress the value of the active co-operation that has long existed in the Mayo Clinic among surgeon, surgical pathologist and roentgenologist in their daily contact in the operating theaters. This active personal co-operation has increased the interest of all three parties, has inspired their mutual confidence, and has promoted their efficiency.[2]

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[2]Discussions of papers read at the Annual Meeting will be published in a later issue of Radiology.

# X-RAY PROTECTIVE PLASTERS[1]

By FRANKLIN L. HUNT and MORRIS TEMIN, National Bureau of Standards, WASHINGTON, D. C.

PROTECTIVE plasters are now used to some extent as a substitute for metallic lead on the walls of X-ray treatment rooms. The characteristics of one such material, consisting of a mixture of barium sulphate and Portland cement, were recently investigated by one of the authors.[2] The purpose of the present survey is to find similar materials suitable for use as protective plasters and of increased protective value, since one of the disadvantages of the mixtures now used is the excessively thick layers required to give adequate protection.

The problem has been to select substances containing one or more heavy elements, such as lead or barium, with large absorbing power for X-radiation, and at the same time of such properties as to possess the requisite strength and serviceability for use as a plastering material. In some materials of this kind the binding constituent itself is protective, while in others a substance of negligible protective value has to be added to bind the inert protective material. In all cases, it is necessary that one constituent of the mixture be sufficiently coarse-grained to meet the requirements of serviceability as a plastering material. This requirement carries with it an inherent disadvantage, from the point of view of X-ray protection, which is characteristic of all protective plasters, namely, that of giving a non-homogeneous material which, unless used in rather thick layers, permits an appreciable amount of X-radiation to pass between the grains of the protective substance. The materials should, therefore, be as fine-grained as possible without injuring them seriously as plasters. Another obvious requirement is that the materials be of such composition as not to crack on setting after application to the walls of the room, otherwise a dangerous amount of X-radiation may pass through the cracks.

In the experiments here reported, mixtures of litharge, barium sulphate, barium silicate, barium carbonate, and barium aluminate were tried. Also, fine lead shot mixed with litharge. The litharge-barium sulphate mixtures were set by the addition of glycerine to the solid ingredients, the barium silicate and barium aluminate plasters by adding water. In one sample, in which only barium sulphate was used, Portland cement was added as a binder. This experiment was an effort to decrease the amount of Portland cement (which is nearly transparent to X-rays) as much as possible relative to the barium sulphate and yet not injure the material as a plaster. Mixtures of litharge and gypsum were tried, but these were poor in protective value on account of the relatively small density of the gypsum. Pure litharge-glycerine mixtures proved to be too brittle to answer the requirements of a plaster. These could be used, however, to fill in small spaces or around tube holders.

For tensile strength tests, one inch standard briquettes were made from each mix and tested in the regular way after aging one, three, and seven days, respectively, in the laboratory. The consistency was uniform for all mixes but was drier than that used commercially. The linear expansion or contraction in setting was measured on specimens $18 \times 2.5 \times 2.5$ centimeters from readings taken over a period of twenty-four hours, under microscopes, at two fixed points on the specimen.

The X-ray protective properties were determined by placing samples of the plaster

[1] Published by permission of the Director of the National Bureau of Standards of the U. S. Department of Commerce.

[2] Barium Sulphate as a Protective Material against Roentgen Radiation, by F. L. Hunt, Am. Jour. Roentgenol. and Rad. Ther., 1925, XIV, pp. 524-528.

TABLE I

| Sample number | Mixture | Gauging liquid | Expansion Changes: Maximum change | Expansion Changes: Time at maximum change | Expansion Changes: Change 6 hours after mixing | Tensile Strength: Age at Test: 1 day | | 3 days | | 7 days | | X-ray Tests: Thickness | Lead equivalent thickness | Protective coefficient |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | % | | % | lb./in.² | kg./cm.² | lb./in.² | kg./cm.² | lb./in.² | kg./cm.² | mm. | mm. | % |
| 1 | 1 Litharge<br>1 Shot | Glycerine | + .039 | 6 hrs. | + .039 | 225 | 15.8 | 290 | 20.3 | 200 | 14.0 | 2.0 | 1.3 | 65 |
| 2 | 1 Litharge<br>1 Ba. Sand | " | — .047 | 45 min. | — .038 | 100 | 7.0 | 180 | 12.6 | 260 | 18.2 | 6.9 | 1.7 | 24 |
| 3 | 1 Litharge<br>2 Ba. Sand | " | — .016 | 45 " | — .010 | 100 | 7.0 | 160 | 11.2 | 170 | 11.9 | 6.1 | 1.4 | 22 |
| 4 | 1 Litharge<br>3 Ba. Sand | " | + .030 | 10 " | — .003 | 20 | 1.4 | 45 | 3.2 | 50 | 3.5 | 4.5 | .81 | 18 |
| 5 | 1 Litharge<br>4 Ba. Sand | " | + .144 | 50 " | + .134 | 8 | .6 | 28 | 2.0 | 38 | 2.7 | 6.2 | 1.1 | 17 |
| 6 | 1 Ba. Alum.<br>2 Ba. Sand | Water | —2.58 | 5 hrs. | —2.58 | 300 | 21.0 | 220 | 15.4 | ..... | ..... | 5.3 | .83 | 16 |
| 7 | 1 Ba. Sil.<br>2 Ba. Sand | " | — .009 | 24 " | — .005 | 95 | 6.7 | 170 | 11.9 | 186 | 13.0 | 5.5 | .88 | 16 |
| 8 | 1 P.C., $3BaSO_4$<br>6 Ba. Sand | " | — .60 | 24 " | — .58 | 90 | 6.3 | 125 | 8.8 | 210 | 14.7 | 6.6 | 1.0 | 15 |
| 9 | 1 Ba. Sil.<br>2 Ba. $CO_3$ | " | — .02 | 1 " | — .02 | 36 | 2.5 | 65 | 4.6 | 73 | 5.1 | 6.8 | .88 | 13 |

All proportions by weight. + represents an expansion. — represents a contraction.

from 2 to 7 mm. thick on a photographic plate beside an echelon made of strips of lead of thicknesses varying regularly in nine steps from 0.3 mm. to 2 mm., and photographing both simultaneously with the unfiltered X-radiation from a standard Coolidge tube excited by mechanically rectified current. The photographic plate was enclosed in a double opaque envelope and protected at the sides and on the back with 3 mm. of sheet lead, to eliminate stray radiation. In some cases fine lead shot was used to fill up spaces not protected by the lead plates. The distance from the focus of the tube to the samples was 50 cm. The time of exposure was two minutes. A current of 10 milliamperes was applied intermittently for ten-second periods with an interval between to cool the tube. The voltage used was that corresponding to an eight-inch alternative spark gap between points, *i.e.,* 125 kilovolts.

The protective value of the materials was determined by comparing the density of the part of the photographic plate under the sample with that under the known thickness of lead of the strips of the lead echelon. This was done with a Martens polarization photometer which made it possible to determine by interpolation the equivalent thickness to 0.01 millimeter of lead. The results are expressed as the lead equivalent thickness of the sample, *i.e.,* the thickness of lead having the same protecting power as the sample. Since the actual protection depends not only on the quality of the material but upon its thickness as well, for purposes of comparison the lead equivalent thickness was divided by the thickness of the sample, giving what is termed the protective coefficient; that is, the lead equivalent of unit thickness of the material. This quotient is expressed in percentage since it is a ratio which is independent of the thickness of the material.

The results of the investigation are given in Table I, in which the compositions, gauging liquids, expansion changes, tensile strength, and X-ray protective properties of the different mixtures are shown. It will be noted that mixtures of litharge and coarse barium sulphate (passed U. S. Standard Sieve No. 12), with glycerine as the gauging liquid, gave nearly twice the protection for a given thickness that barium sulphate plasters mixed with Portland cement did, the latter having an average protective coefficient of approximately 13 per cent.[3] We were able to decrease somewhat, though not greatly, the amount of Portland cement without injuring the material as a plaster. This is shown by Sample No. 8 of the table. Sample No. 5 would probably be too weak for a serviceable plaster. No. 6 showed excessive contraction and is, for this reason, not recommended. Sample No. 8 would require the addition of a retarder for commercial use.

The best showing from the point of view of protection was made by fine lead shot (diameter 1.25 mm.) mixed with litharge and glycerine. With a sample only 2 mm. thick, which gave a distinctly granular mixture, as indicated by the mottled appearance of the photographic plate, the average protective effect was nearly 7/10 of that of metallic lead, and with a sample 5 mm. thick no detectable amount of radiation reached the photographic plate. The presence of litharge also makes the combination a fairly good electrical insulator (resistivity $10^7$ ohm-cm.), which is of advantage in minimizing electrical hazards. This combination could be used where the protective material has to be molded around irregular shapes and for filling narrow spaces or for tightening joints. If used as a plaster, on account of the weight to be supported, special framing would be required.

Relatively small amounts of materials were available for the tests, so that large-scale experiments on the plasters were not possible. Hence, such properties as workability, which is important in all plasters,

[3] See Footnote 2.

could not be tried. The results given above should, therefore, be considered as indicating the possibilities of the materials considered, rather than as proof of their suitability for general use. It may be safely concluded, however, that for small-scale operations at least, most of the mixtures considered afford more effective protection than barium sulphate mixed with Portland cement.

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**Deep therapy in bladder tumors.**—This paper gives the results in deep therapy of bladder tumors over four years' time in 120 cases. These include 90 per cent papillary and 10 per cent adenocarcinoma, epithelioma and squamous cell carcinoma, classified by the gross rather than the histologic method, depending on the infiltrating or non-infiltrating character. The author finds that fulguration gives excellent results in benign and malignant tumors, which even radical surgery cannot approach. Fulguration gave better results in the treatment of papillomata than of malignancies. Hopelessly inoperable infiltrating growths responded better to treatment by radium, deep therapy and diathermy.

Results were obtained in about 75 per cent of neoplasms by fulguration with intravesical application of radium through the urethra; and after suprapubic incision, destruction of the tumor mass with cautery. The remaining 25 per cent of tumors involving the trigone or vesical orifices or very extensive infiltrating growths were hopeless. The use of glass emanation tubes has been discontinued due to the resulting sloughing of burns.

In the cases where the above mentioned methods were unsuitable, results were obtained by roentgen-ray treatment, with careful watching and frequent examinations of the patient. Repeated blood counts, particularly of the white blood cells, were helpful in controlling the treatment. In spite of the disturbing reaction, relief was afforded, especially from pain and hematuria.

Case reports and results of treatment by different methods are given, together with many illustrations of the tumors before and after treatment.

The benefit from these treatments may be prolonged over periods of time if the patients will co-operate by reporting at frequent intervals and submitting to further treatment as necessary.

TRESSA R. MORAN, M.D.

*Four Years' Experience in the Treatment of Tumors of the Bladder by Deep Roentgen Therapy. Charles A. Waters. Am. Jour. Roentgenol. and Rad. Ther., September, 1926, p. 203.*

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# UNIFORM VOLTAGE *VS.* PULSATING CURRENTS IN CLINICAL DEEP THERAPY[1]

By A. MUTSCHELLER, Ph.D., NEW YORK CITY

WHEN we consider that nearly all the physical research work on the nature of X-rays has been and is performed with constant voltage current, it is somewhat strange that for clinical therapy this type of current is not employed in preference to the now so extensively used pulsating high tension current. With comparison tests, up to about 160,000 volts, it has been shown definitely by Glocker that constant voltage possesses many distinct advantages over pulsating current. But technical difficulties and bulkiness and unreliability of the apparatus are the usual reasons why the advantages of constant voltage current are not admitted and utilized. Recently, however, the technical development of constant voltage apparatus has progressed to the point that now for clinical purposes it is fully practicable to operate deep therapy tubes with 200,000 to 250,000 volts of fully uniform voltage current.[2]

It is, therefore, the purpose of this investigation to determine the differences between radiations for hot cathode X-ray tubes operated with uniform voltage and with pulsating current of 200,000 volts, and to point out in particular the advantages and disadvantages of one type of current over the other with respect to their clinical utility in short wave length radiation therapy.

A standard rectifier type apparatus was operated at 200,000 volts, energizing a hot cathode deep therapy tube with 4 milliamperes of tube current. This radiation was then compared with the radiation output from the same tube, also energized with 4 milliamperes of constant voltage current at a voltage producing the same minimum wave length radiation as that measured on the spectrogram of the 200,000 volt pulsating current. This, then, is an assurance that the same voltage existed between the electrodes of the tube in the two cases.

The X-ray tube was identically supported and cooled in a well ventilated lead-lined drum and the measurements were all made with the same instruments and under the same conditions by simply exchanging the connections to the tube from one machine to the other.

*Erythema doses* of the two equipments were measured with an instrument that about two months previously had been standardized at the Physikalisch Technischen Reichsanstalt by Dr. Behnken, with the same standard pressure ionization chamber with which he had established the electrostatic unit of X-ray dose which is now in Europe accepted as the *R*-unit. The instrument employed consists of a small graphite ionization chamber rigidly connected with the string of a Wulff electroscope. The chamber was half submersed in water at a distance of 50 cms. from the tube target, and measurements were made first without filters and then with ½ mm. of copper as a filter. The discharge times representing 900 *R*-units of a first degree erythema dose with mechanically rectified current were, without filter, 72 milliampere minutes, and through a ½ mm. copper filter

*Erythema Doses of 900 R, 50 cms. distance*

| | No filter | ½ mm. Cu. |
|---|---|---|
| Rectified Current | 72 ma. min. (100%) | 272 ma. min. (100%) |
| Constant Voltage | 52 ma. min. (138%) | 183 ma. min. (149%) |

*Depth doses 60 cms. through 10 cm. $H_2O$*

Rectified Current 38% (100%)
Constant Voltage 43.2% (112%)

[1]Read at the Twelfth Annual Meeting of the Radiological Society of North America, at Milwaukee, Nov. 29–Dec. 4, 1926.

[2]Am. Jour. Roentgenol. and Rad. Ther., 1926.

272 milliampere minutes. The constant voltage current gave the same doses in 52 milliampere minutes without filter and in 183 milliampere minutes with ½ mm. copper as a filter.

From this we observe that, with the constant voltage current, an erythema dose without filter is obtained in 72 per cent of the time and with a ½ mm. copper filter in 67 per cent of the time required for the same dose with mechanically rectified current.

Conversely, for equal exposure times, the dose for unfiltered constant voltage current radiation is 38 per cent larger, and the same radiation filtered through ½ mm. copper is 49 per cent larger than the same dose from pulsating current rays.

It is further noticeable at this instant, that the shortening of the erythema time is greater with a filter than without one. This fact must be interpreted as being due to the different compositions of the two beams, which are such that the pulsating current beam contains more long wave length rays and, therefore, requires a thicker filter for the same result than the ray beam from the constant voltage current.

*Depth doses* were measured with the two equipments by lowering the ionization chamber 10 cms. into the water basin, thus making the total target-to-chamber distance 60 cms. The depth dose under 10 cms. of water with pulsating current was measured to be 38 per cent of the incident dose of radiation filtered through ½ mm. of copper; constant voltage current gave a depth dose of 43.2 per cent of the equally filtered incident dose, therefore 11.4 per cent greater than the pulsating current.

Equal exposure times give depth doses which are not only the result of an increased initial radiation intensity but also of greater depth doses, as we have seen in this and the preceding paragraphs. Thus, constant voltage current gives a surface intensity of 139 per cent of that of pulsating current. Therefore, the total transmission of constant voltage current radiation to a depth of 10 cms. of water is $139 \times 1.12$, or 155 per cent of that of pulsating current radiation.

*Average wave length* measurements give the wave length of a homogeneous or monochromatic radiation which has the same absorption coefficient as the radiation tested after it is sufficiently filtered to have a constant absorption coefficient. It is determined from an absorption curve in copper, plotted and interpreted as previously described,[3] and the conclusions that can be derived from the curves obtained in Figure 1 are that for the pulsating current a filter of not less than 0.5 to 0.6 mm. of copper is required, but that for constant voltage current a filter of 0.4 mm. of copper is fully adequate and sufficient. It further is determined that the percentage of radiation transmitted through the filter, *i.e.*, the useful portion from pulsating current, is 26.5 per cent of the total radiation, and from constant voltage it is 34 per cent of the total radiation generated. The average wave length for the pulsating current radiation is 0.145 Å. U., and for constant voltage current radiation it is 0.140 Å. U., which indicates that the doses under 10 cms. of water should be about 12 per cent larger from constant voltage than the depth doses obtained with pulsating current. These indications are in keeping with the results found by the direct measurement reported above.

*Spectra* show the distribution of the wave lengths of the two radiations in a very clear way. The intensities of the different wave lengths were estimated from photographic spectrograms obtained with a rocking spectrograph containing a sodium chloride crystal and the intensities of the blackening of the film were estimated by a method similar to that of Glocker and Kaupp[4] but somewhat modified in order to eliminate some of

[3] Ionometer for Relative Measurement of Primary X-rays, A. Mutscheller, RADIOLOGY, May, 1924, p. 330.

[4] Accuracy of Potential Measurements with a Spectrograph, Strahlentherapie, 1926, XXII, 160.

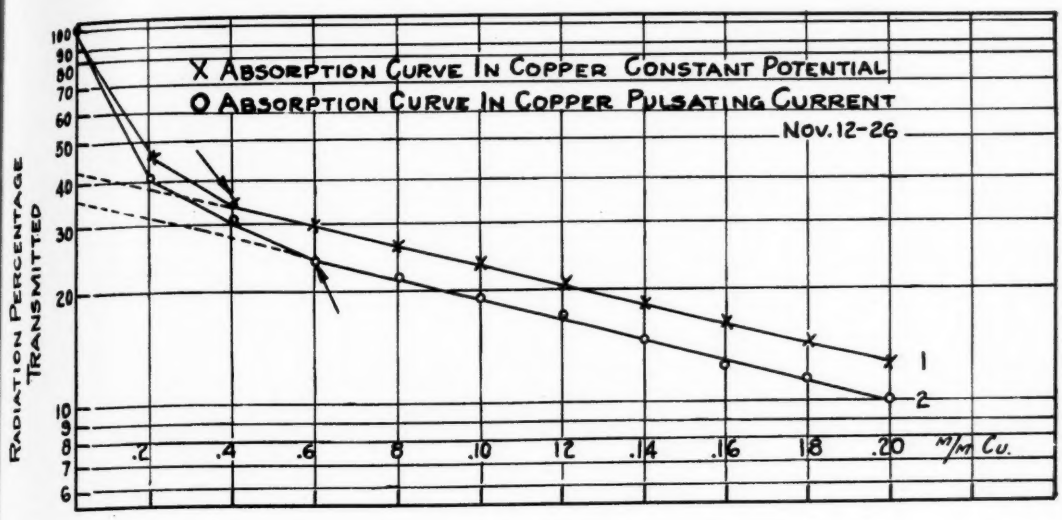


Fig. 1. See text, page 122.

the errors inherent in the direct photometric estimation of the intensity values. Instead of that, a direct side-by-side comparison was made of the photographic spectrum with a photographic scale of gradually increasing radiation intensities, prepared by exposing a duplitized film between the same intensifying screens as those employed for obtaining the spectra, by gradually increasing the exposure time along this scale. Being, therefore, exposed and developed under exactly the same conditions as the spectra, the scale employed eliminates automatically the modifying influence which may be due to the characteristics of the photographic material, the intensifying screens, the developing method, *et cetera.*

The intensities of the spectrum were then read off this scale under the microscope, when the blackening was equal to that of the scale, and the length of the scale in millimeters was then plotted as a measure of the intensities of the blackening.

The spectra of unfiltered radiation are plotted in Figure 2 and they show clearly that the constant potential current radiation contains a very distinctly larger component part of short wave length rays than the radiation of pulsating current. This is indicated by the fact that the maximum intensity of the constant voltage current radiation is at 0.18 Å (or 70 kilovolts) and that of the pulsating current radiation is at 0.26 Å (or 58 kilovolts). By drawing a vertical line between these two points we find that the areas under the curves representing radiation intensities show that the maximum intensity of the constant voltage current radiation is considerably more toward the short wave length end than that of the pulsating current radiation. While a quantitative interpretation is not possible, these results nevertheless are convincing and visible evidence in support of the results of the quantitative measurements reported in the preceding paragraphs.

## DISCUSSION

When a constant and non-varying voltage is applied to the electrodes of an X-ray tube, then a definite wave length intensity distribution, or spectrum, is obtained, such as the dotted line spectrum plotted in Figure 3. A spectrum of this kind is conveniently represented diagrammatically in a

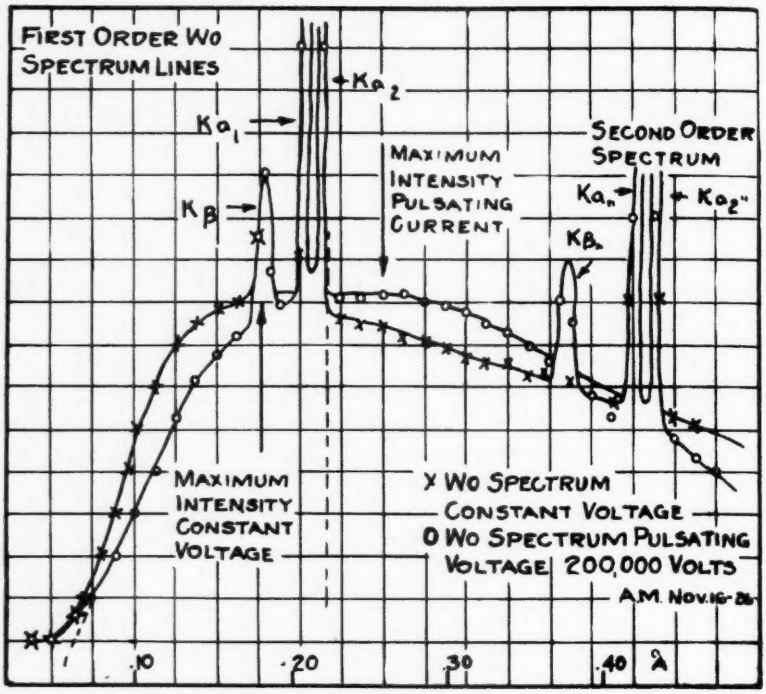


Fig. 2. See text, page 123.

two dimensional space diagram. But when a varying voltage is applied to the X-ray tube, such, for instance, as a sinusoidally varying transformer current, then a series of spectra will be produced, the minimum wave lengths and the maxima of which shift toward the longer wave length end of the spectrum as a function of the voltage, and so an infinite series of spectra result which are to be plotted in the third dimension, as shown in Figure 3. These may be projected upon the first original plane, giving rise to a curve with the same minimum wave length as the original spectrum but having its maximum shifted towards the longer wave length end.

The experimental results described in the preceding sections and the preceding analysis fully justify and support the following two very important corollaries:

(A) Unlike mechanically rectified high voltage current, the constant voltage current produces, with the same voltage, always the same spectrum and as the influence of rectifier and changing primary voltage characteristics are entirely eliminated, it is fully possible to express and to compare doses as the milliamperes and the voltage applied to the tube.

(B) Constant voltage current produces a spectrum with the largest possible component of short wave length rays, and, conversely, a varying voltage always produces a spectrum whose maximum intensity is shifted towards the long wave length end, and which, therefore, is richer in less penetrating rays.

For the reason that the voltage constancy of a uniform voltage apparatus depends, for a given load, upon the size of its condenser, it follows also that the penetration quality and therefore the extent of usefulness of such a radiation depends upon the electrostatic capacity of the condensers present in

the apparatus, and to that end the condensers should be as large as is economically possible. Small capacities connected across the terminals of a mechanical rectifier are, therefore, not a means of effectively increasing to the highest maximum the short wave length components of a given radiation. Large capacities so connected generally cause entirely too much sparking at the rectifiers to be applicable for the intended purpose.

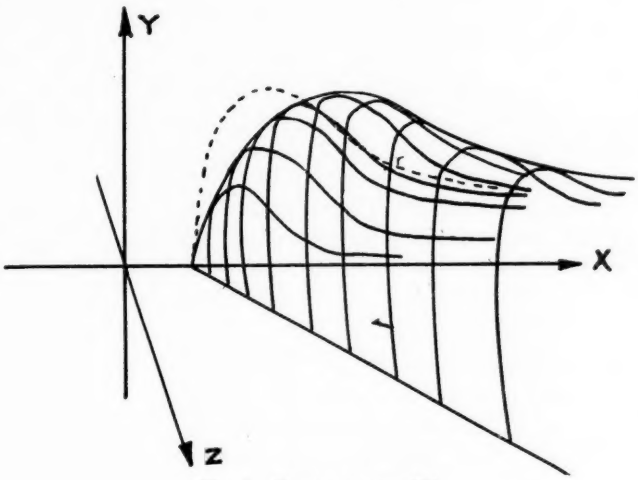


Fig. 3. See text, page 124.

## SUMMARY

The results of this investigation can be summarized in the conclusions:

1. That surface doses obtained with constant voltage radiations are considerably larger than those obtained with rectified current, and that the depth doses of constant voltage radiations are increased in a greater proportion than surface doses.

2. The average wave length of the constant voltage radiation is distinctly shorter than that of pulsating current radiation, and the spectra show clearly that the constant voltage radiation contains a smaller percentage of long wave length or low penetrating rays than the pulsating current rays.

3. Due to this fact, the same extent of absorption uniformity or "homogenization" can be obtained with a thinner filter in the case of constant voltage rays than with pulsating current rays.

4. Furthermore, for equal energies forced through a tube the useful penetrating radiation from constant voltage current at 200 K.V. operation is, on the average, slightly over 1½ times as great as in the radiation obtained from pulsating current rectifiers.

While Glocker had recognized similar advantages when operating his apparatus at lower voltage, it is found in this investigation that the advantages of constant voltage current distinctly increase if the tube can be operated at still higher voltages. Constant voltage current may bring about a distinct reduction in the erythema dose time, but the real advantages of constant voltage current begin to become increasingly prominent and really worthwhile when voltages of about 200 K.V. are applied to the

tube. With the perfection of constant voltage apparatus, enabling one to operate therapy tubes with 200,000 volts, the advantages of constant voltage over the pulsating current for rational and effective deep therapy are, therefore, undisputably established.

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**A new gall-bladder dye.**—The author reports his experience with a new compound which he used intra-orally for the visualization of the gall bladder. It is a combination of iodin and atophan, of the formula $C_{16}H_9O_2NJ_2$, and contains approximately 50.5 per cent iodin. Doses of from 5 to 6 grams dissolved in 250 c.c. cocoa are usually sufficient. This preparation has never caused any undesirable reaction. There is only a scratching sensation in the throat which subsides after swallowing a piece of bread. It is advisable to inject hypophysin or pituglandol before, in order to empty the gall bladder. The gall-bladder shadow is very distinct and intense and, in the opinion of the author, superior to that after oral administration of tetraiodophenolphthalein.

E. A. POHLE, M.D.

*Regarding a New Contrast Substance for the Roentgenological Visualization of the Gall Bladder. B. O. Pribram. Deutsch. med. Wchnschr., July 30, 1926, LII, 1291.*

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# RADIO-ACTIVE SUBSTANCES: THEIR THERAPEUTIC USES AND APPLICATIONS

## THE APPLICATION OF RADIUM TO CARCINOMA OF THE ESOPHAGUS

By JOSEPH MUIR, M.D., NEW YORK CITY

IN the entire history of therapeutic endeavor there is no more melancholy chapter than that which relates to the treatment of esophageal cancer. For many centuries past, and up to within the memory of men still actively engaged in the practice of medicine, this disease has been regarded as absolutely incurable from its very inception, and, as a consequence, surgeons have largely ignored it, and other therapists have confined their efforts solely to making the sufferer's passing as easy as the circumstances would permit. And when one considers that to the horrors of death from malignancy in any form, in this type are added those of starvation and in many cases—where the larynx becomes involved—suffocation as well, it is easy to understand what terror the very suggestion of this lesion carries to physician and layman alike.

When the therapeutic possibilities of radium were first discovered, the advent of this new agent for combating malignancy was hailed with joy by every one who had to do with this much-to-be-dreaded disease. As early as 1904 we have records of the use of radium in cancer of the esophagus, for in that year the German scientist, Exner, reported the treatment of three cases by means of a 60-milligram tube of radium element carried to the desired position on an esophageal bougie. In the same year Max Einhorn in this country, apparently unaware of Exner's attempt, gave an account of nine cases wherein radium had been used, the following year adding seven more cases to this series. All of these attempts were, however, at the time of reporting, too recent to allow any definite conclusions to be drawn, and those who later on did make further communications, never seemed to have definite information as to the results of earlier work.

As much later as 1915 we find Chevalier Jackson, in his justly celebrated monograph on peroral endoscopy, saying that he had not as yet seen any results from the use of radium in the esophagus that would justify his urging its employment in any case of malignant disease that was amenable to surgery. He admitted that he had seen markedly beneficial effects in inoperable esophageal malignancy, but so far no absolute cures. In none of the cases which had come under his observation had sufficient time elapsed to enable one to pass final judgment upon the value of radium therapy in neoplasms.

Just about the time Jackson wrote this book, Lewin, a German, reported the successful outcome of twenty-five cases—successful in so far as the immediate relief of subjective symptoms was concerned. His method consisted in making an exposure of from two to four hours, two or three times a week for five weeks, using 50 to 80 milligrams of radium, screened with gold or platinum, with an outer covering of hard rubber. The radium container was held in place by a bougie.

At the Radium Institute, London, twenty-five cases of esophageal cancer were treated by Hayward Pinch and his co-workers, between 1914 and 1918. Pinch tabulated his results as follows: Patients showing improvement, 3; unimproved, 5; dead, 9; refused further treatment, 3; final results not known, 5. In New York a report of work done at about the same time at the Postgraduate Hospital was made by H. H.

Forbes. Six patients had been treated, one of whom had died from hemorrhage. A 25-milligram tube of gold, further screened with rubber, was used in these cases, the tube being passed through an esophagoscope under fluoroscopic visualization. It was held in position by an attached thread, the other end of which was fastened by adhesive plaster to the patient's cheek. No cures were claimed, but the author felt that symptomatic relief had been obtained in all instances, and that the comfort and general *morale* of the patients had been greatly augmented.

On the whole, however, after a few years of trial and disappointment, the radium therapists became even more profoundly discouraged than the surgeons had been before them, and the history of radium treatment of this malignancy is, for the most part, merely a repetition of the failures which had invariably terminated every previous form of therapeutic endeavor. In 1916, Janeway, of the Memorial Hospital, New York, wrote that epithelioma of the esophagus "should offer peculiar opportunity for successful treatment by radium"—his results had been "most disappointing," however — and that his experience "only too sadly demonstrated the necessity for the greatest care in adjusting the dose to the growth." Yet he ended with an expression of optimism, asserting that he still believed radium to have a "wide field of usefulness in cancer of the esophagus."

In 1923, however, following Dr. Janeway's death, his assistant and successor, Douglas Quick, made another report covering a period during which 92 cases of carcinoma of the esophagus had been treated. These presumably included Janeway's earlier series. Of these cases Quick admitted that there was not a single one that could be classed as even clinically cured. One patient had lived more than four years, but finally died, presumably from metastasis. The next year Quick was even more despondent, and stated that no matter what means of treatment one might employ, the disease would be fatal in "practically 100 per cent of cases." From the employment of radium he now hoped for nothing more than palliative relief.

Not all those who early began to use radium in the malignant esophagus were so disillusioned, however. As early as 1911 the English laryngologist, G. William Hill, presented to the Medical Society of London a series of 22 cases of "malignant stricture of the esophagus" which he had treated by intubation and radium, working in conjunction with Nils Finzi. They had used from 50 to 200 mgr. of radium element, for periods varying from 12 to 28 hours, repeated in some instances as many as six times. They claimed four temporary cures; in six other cases there was quite remarkable improvement; in seven further cases substantial improvement, and in five cases there was no improvement whatever. After a lapse of fourteen years we again find Hill reporting on his use of radium to combat esophageal cancer, and his attitude is very evidently still a hopeful one, although of his added 55 irradiated cases, he is careful to mention that "not all the later ones were so carefully selected as those in the first series already reported." In addition to the good results he told of in 1911, he now had "at least four further cases in which there was apparently a temporary local disappearance of gross evidence of growth when the diseased area was visually examined with the aid of the esophagoscope. The temporary freedom from recrudescence of growth lasted in those four cases from six to eighteen months." His results to the time of writing he sums up as follows: "In about one-third of the cases there was remarkable improvement; in another third, very substantial improvement, and in the remaining third the improvement was either very slight and fleeting, or there was no improvement at all, or the patient was rather worse than before.

In three cases the measure was followed by fatal results within a few days of the application."

Despite the cheerful tone of these reports one cannot but feel that they give but slight basis for a hope that radium can control esophageal malignancy, and about the best that can be said for the work done while the method still remained that of permitting the radium container to dangle at the end of a string passed downward from the mouth, is expressed in the words of Simpson, written in 1921: "In this all but hopeless disease the results of radium have been encouraging."

Some radium therapists, however, kept up the struggle, even in the face of what appeared to be overwhelming odds, and made every endeavor to find a more adequate treatment for esophageal malignancy. As we examine the considerable literature upon this subject which has accumulated during the last few years, the difficulties to be encountered and overcome are well evidenced by the great variety of these attempts. Hanford, of Chicago, for example, made use of a three-sectioned whalebone applicator, which was attached to a string and put in position with the aid of fluoroscopy, for the facilitation of which a barium meal had been previously administered. At the Mayo Clinic about the same period a similar apparatus was in use. There was, however, no standard technic of application of radium to the esophagus; indeed, this is quite as true to-day as it was in 1920. The requisites to successful placing and application of radium to this lesion were listed by Mills and Kimbrough as follows: (1) a knowledge of the location and physical peculiarities of the tumor and the resulting stricture, especially as to location, extent, direction and the degree of stenosis; (2) a means of effective and non-traumatizing canalization of the cancerous stricture; (3) a mechanical means of maintaining the radium in direct application with the tumor; (4) a ready means of frequent observation as to the position of the radium during the period of treatment, and (5) a careful selection as to dose, filtration and frequency of treatment, guided by such experience as we have and the individual peculiarities of the case. After reviewing all that had been done up to that time these authors concluded that this method of treating cancer of the esophagus by radium was "hopeful." The most encouraging feature of the small series of cases they had treated was the relief of dysphagia, and for palliative treatment they were positive radium was the best medium that had ever been available; "at least, patients may live to die of less agonizing consequences than result from esophageal stenosis." And they ended by saying that "from a consideration of all the factors, the possibilities of the ultimate cure of certain cases of cancer of the esophagus must be held as a possibility."

The present attitude of the medical profession generally in regard to any kind of treatment of esophageal malignancy was well represented at the recent meeting of the American Association for Thoracic Surgery. On this occasion one of the participants in the program remarked that as cancer of the esophagus had always been regarded as incurable *very little attention had been paid to it.* The italics are mine, for it seems to me that in these words we have the explanation of the continual failure of all curative efforts directed toward this lesion. Had the same intensive investigation and study been given to this neoplasm as has been accorded carcinoma of the uterus or of the lip, for example, or had an equally diligent campaign of education among the laity and general practitioners been directed against it, it is highly probable that there would be more cured cases in evidence to-day. Owing to the great distensibility of this organ a growth may attain considerable dimensions before any indication of its presence will be evident to the patient, and consequently many months usually elapse before any kind

of treatment is applied to it. This neglect until the lesion is far advanced is just as great a drawback to successful surgery as to advantageous application of radium, and, so far, the only case of esophageal carcinoma which surgery has ever cured appears to be that of Torek, whose patient lived for twelve years after operation and finally died of pneumonia when she had almost attained the age of eighty.

But other surgeons, though they have followed the technic of Torek most faithfully, have not seen their efforts crowned with a like success. In a paper which this operator presented at the meeting alluded to above, he cited several other reported surgical cures, but the profound pessimism of the surgical world does not seem to be in any way altered by these hopeful reports, and on investigation we are apt to find that the supposedly cured patient passed away long before the five-year period had elapsed. And, as we have seen, the performances of those who pinned their faith to radium have been not a whit more brilliant. Stone, of the Memorial Hospital, who was on the program to speak of radium therapy in carcinoma of the esophagus, announced that he wished to emphasize the dangers of radium treatment to be avoided by those who are taking up this work, and advised them to take warning from the ill success which had attended the efforts of the late Dr. Janeway and his associate, Dr. Quick, not a single one of whose cases "can be said to have been cured by radium." Yankauer, another radium therapist who was supposed to present the viewpoint favoring this form of treatment, described his method of application, which consisted of preliminary gastrostomy, after which a chain of radium emanation containers with strings at each end, was passed from the mouth to the gastrostomy opening, the position of the radium being watched by fluoroscopy and adjusted from either end until the containers were exactly in the region of the carcinoma. The dosage was 100 mc. hours, applied at intervals of two to three days until 1,000 to 1,500 mc. hours had been delivered. The palliative effects of this therapy he apparently ascribes fully as much to the gastrostomy and "the fact that there is a string passing through the carcinoma" as to any beneficial influence of the radium applications.

In the face of such profound pessimism it requires some courage to put forward a variation on the methods heretofore used, and still more to claim for it any greater promise of success than has up to the present been attained. Yet it is not too much to say that by the procedure I am about to describe most of the paramount objections to the use of radium in the esophagus have been overcome, and although its application is too recent to permit of any generalizations as to final results, there seems to be every reason to believe that it offers the most hopeful prognosis that anyone has ever been able to hold out for this disease.

The greatest difficulty encountered by radium therapists working in the esophagus has always been the production of necrosis if the implantation method was used, or inadequate radiation of the deeper tissues if the application were made only to the lumen of the esophagus, that is, upon the surface only. Perforation occurs very readily and is practically certain to be immediately fatal, so necrosis must absolutely be avoided if we are to hope for any degree of success. But success is equally dependent upon even distribution of the therapeutic but noncaustic rays throughout the lesion, and the implantation method appears to be the only one which can be depended upon to accomplish this result. It follows, therefore, that a unit of radio-activity which can be implanted, yet is so completely screened as to produce no burning and subsequent necrosis, is the only form which can accomplish its purpose satisfactorily. Platinum needles have heretofore most nearly fulfilled these conditions, but they are by no means per-

fectly screened, and, moreover, are so difficult to immobilize for a time sufficiently long to permit of a proper exposure, that their use has never become popular.

The platinum radon seed, however, has all the advantages of the needle, with none of its drawbacks. It is easily applied, can be withdrawn after the desired period of radiation is completed, and has a definite dosage which can be relied upon to give off sufficient radiation within the malignant mass. Complete visualization of the entire area to be treated is absolutely essential, and when this is attained, it is our experience that the radio-active center can be relied upon with the same confidence we feel in applying it to easily accessible malignancies. Through the esophagoscope, only that portion of the lesion presenting in the lumen of the esophagus itself can be seen. In very early cases this might constitute the entire neoplasm, but as early cases practically never come under observation, the growth, when first seen, will have infiltrated far beyond the range of the esophagoscope, and any applications made to this visible area alone will reach only a trifling fraction of the infiltrated tissue. Therefore, very careful preliminary fluoroscopy is essential that the operator may be fully cognizant of the extent and characteristics of the lesion he proposes to treat. When he is in possession of this information he must be equipped with instruments capable of conveying the radio-active centers to the various parts of the growth so that when the implantation is completed every part of the lesion will be evenly and fully irradiated.

To accomplish this a set of esophageal radium implanters has been designed by means of which the seeds can be placed through the esophagoscope at varying depths, according to the size and dimensions of the neoplasm. Thus, one seed may be placed at a depth of 5 cm. from the lumen of the tube, a second at 3 cm., and a third at one centimeter. The angle of the instrument can then be changed slightly, and three more seeds similarly placed in another part of the growth. The exact amount of radiation which will be given off by each seed can be reckoned beforehand and the seeds placed at precisely measured intervals, so that all "guess work" is eliminated and every part of the lesion is certain to receive a full dose of non-caustic radiation.

It is, of course, too soon to make any positive assertions concerning the permanent value of this therapy. A number of cases have been treated recently by this technic, and so far the most promising immediate results have been produced. The whole procedure is carried out at a single sitting, there is no systemic reaction, and even the great debility usually presented by the victims of esophageal cancer is in no way increased by the maneuver. It must be admitted, however, that the proper placing of the seeds in a region so highly inaccessible as the esophagus requires a considerable degree of manual dexterity, wide experience in the manipulation of the endoscope, and a most thorough knowledge of the anatomy of the parts involved and the extent and character of the particular lesion under treatment. But after all, these requirements are no greater than those which restrict the surgeons who essay to treat malignancy in this region, and, under proper conditions and in competent hands, the promise of this particular technic is certainly greater than anything heretofore brought forward.

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# TABETIC SPINAL OSTEO-ARTHROPATHY[1]

## WITH REPORT OF FOUR CASES

By JOHN L. GARVEY, M.D., and ROBERT LEE GLASS, M.D., ANN ARBOR, MICHIGAN

OF the various lesions which affect the spine there have been few so rare as the osteo-arthropathy occurring in tabes. Considered almost as a curiosity in medicine, this particular affection of the spine has been observed but sixty times since first discerned by Charcot, now almost fifty years ago. Hidden in the lumbar region, producing deformity but not pain, stealthy in its onset, relatively benign in the type of its manifestations, it gives no inkling of its presence to either patient or physician, and is found out only through chance or purposeful search.

The few cases in the literature well attest the retiring nature of this arthropathy. Frank (1), in 1904, could find but twenty-six cases for his Sammel-Referate, which he published in that year. During the two ensuing decades occasional mention of the condition was made, and in 1923 Henri Roger (2), writing in the *Paris Médical*, estimated the total number of cases to be about sixty. Since then but one additional report of a case has been published, that of Wittkowsky (3), of Berlin. We find but six reports of the condition in America. Cornell (4) reported the first case in this country in 1902 and was followed in the order named by Spiller (5), Campbell (6), Patrick (7), Holmes (8), and Funsten (9).

While reports of the affection have been relatively few, it is our opinion that the condition occurs more frequently than has been observed. Unknown to the patient, because it gives him no symptoms, and unsought by the physician, who usually makes no special examination of the spine once he has established the diagnosis of tabes dorsalis, we feel that it frequently eludes discovery. Our own experience leads us to the conclusion that more cases of tabetic spinal osteo-arthropathy would be found if the condition were sought more often. By directing particular attention to the spine of each tabetic who has passed through the University Hospital in the past eight months, we have discovered four undoubted cases of Charcot spine and have a fifth suspected case under observation. Believing the four unquestioned cases will form a valuable clinical report, we wish to record them in fair fullness, drawing from them what conclusions we may.

Case 1. A male forty-seven years of age, single, a cook by occupation, first entered the Clinic for Neurology of the University Hospital, June 18, 1923. He complained of a burning sensation in the lower abdomen, difficulty in walking, a "loose" right ankle, and curvature of the spine. His family history was negative. When twenty-two years of age he had had a primary syphilitic infection. Two years before his entrance to the University Hospital he had experienced sharp, shooting pains in the lower extremities and numbness in the feet and finger tips, symptoms which had become progressively worse. Following an examination in a Detroit clinic he was given intravenous and intradural anti-luetic therapy without improvement. During a general physical examination preceding an operation for right inguinal hernia, in 1922, his attention was called to a slight curvature of the spine. A steel brace was applied to correct the deformity, but he declared it gave him no relief. He soon began to have a burning sensation in the lower abdomen and difficulty in controlling the right ankle. This he described as a "loose joint," and

[1]From the Department of Neurology, University of Michigan Medical School.

stated that it also was treated by the application of a steel brace.

Examination in this hospital showed a rather poorly nourished, middle-aged male. The facial expression was of the tabetic

Fig. 1. Case 1. Showing a large rounded kyphos extending from the tenth dorsal to the third lumbar vertebra, associated with some scoliosis at the same level.

type. The pupils were equal but reacted poorly to light. They reacted well in accommodation. No speech defect was noted. The tendon reflexes were all lost. There was a marked spinal ataxia associated with a loss of all forms of deep sensation. Superficial sensibility was preserved. Considerable weakness of the dorsal flexor group of muscles of the right foot was noted. Examination of the spine showed a large, painless kyphos of the lower dorsal and upper lumbar region. It was not associated with fixation or muscle spasm. Stereoscopic films of the mid-spine showed a large shadow of lime density at the level of the first lumbar vertebra. This area obscured the outline of the twelfth dorsal and the first and second lumbar vertebræ. Other films of the spine revealed no evidence of bony pathology. Lateral and antero-posterior films showed no evidence of bony involvement of the right ankle joint. However, definite evidence of calcification of the right posterior tibial artery was noted. Both the Wassermann reaction and Kahn precipitation test for syphilis were strongly positive on the blood, the Wassermann reaction on

Fig. 2. Case 1. The spine at the level of the kyphos, showing slight scoliosis to the right, with some rotation.

the spinal fluid being also strongly positive. Examination of the spinal fluid showed sixteen cells per cubic millimeter and a heavy increase in albumin and globulin. The patient was treated with intramuscular injections of mercury succinimid, but showed no improvement during his stay in the hospital.

On September 6, 1925, he returned to the University Hospital, still complaining of sharp, shooting pains in the lower extremities, difficulty in walking, foot drop and curvature of the spine. Incontinence of urine and, at times, of feces had developed since his examination in 1923. The findings on neurological examination had not changed materially since his previous entrance. Wassermann reactions on the blood and spinal fluid remained strongly positive. The colloidal gold curve was 12223322100 and the mastic curve 244320. Examination

of the spine (Fig. 1)[2] disclosed a large rounded kyphos extending from the tenth dorsal to the third lumbar vertebra, associated with some scoliosis at the same level. The kyphos became somewhat smaller when the patient was in the prone position. The thoracic cage impinged upon the iliac crests. A widely disseminated systolic murmur was heard over the spinal deformity, probably produced by kinking of the aorta, a change secondary to the shrinkage in length of the vertebral column. No evidence of aneurysm of the abdominal aorta could be found on physical or roentgenographic examinations, while, during the course of the latter, studies of the spine (Fig. 2) at the level of the kyphos showed slight scoliosis to the right, with some rotation. In the region of the eleventh and twelfth dorsal and first lumbar vertebræ there was definite evidence of vertebral destruction and loss of the joint spaces. The plates showed new, irregular bone production at the point of deformity.

Case 2. A male, thirty-seven years of age, a stationary engineer by occupation, first entered the Clinic for Neurology in November, 1921, complaining of difficulty in walking. At nineteen he had had a chancre. This was followed later by a loss of hair. At twenty-two and at twenty-seven he had had "soft chancres." Since then he had been treated for syphilis with mercury pills, potassium iodide and a total of one intradural and eight intravenous injections of salvarsan. During the past three years he had noticed some difficulty in walking. Examination showed a spinal ataxic gait. The pupils were unequal, the left being about twice the size of the right. Both were fixed to light but reacted well in accommodation. There were no extra-ocular palsies. All the tendon reflexes were lost and there was marked impairment of deep sensibility in the lower extremities. The Wassermann reaction on the blood was negative, but in spite of this negative Wassermann reaction a diagnosis of tabes dorsalis was made.

The patient was not seen again until January, 1926, when he returned to the clinic for re-examination. He said that he had taken potassium iodide by mouth almost constantly since his previous entrance to the hospital, but had had no other anti-luetic treatment. In the interim he had experienced sharp, shooting pains in the legs, and of late a "ripping, tearing pain" along the left tibia. The pains were aggravated by walking. He had also observed impairment of his vision. Objective examination gave essentially the same findings as those obtained upon his first entrance to the clinic. In addition, there was evidence of early optic atrophy. Wassermann reactions of the blood and spinal fluid were negative. The spinal fluid contained thirty-four cells per cubic millimeter, increased albumin and globulin, and was slightly xanthochromatic. The colloidal gold and mastic curves showed rises in the tabetic zone. At the time of the lumbar puncture a deformity of the lower spine was noted, careful examination showing this deformity to be of the nature of a lumbar lordosis, associated with scoliosis to the right. There was bulging of the tissues to the right of the lumbar spine, but retraction to the left. The thoracic cage had descended until the ribs were well down in the pelvis. By stretching upwards the patient was able to lift the ribs above the iliac crests, while this movement also caused obliteration of the lumbar lordosis and corrected the depression to its left and the tumescence to its right. On backward bending there was definite restriction of movement of the lumbar spine. Most of the motion took place in the lumbo-dorsal instead of in the lumbo-sacral region. Forward bending caused accentuation of the lumbar scoliosis and increased prominence of the right spinal transverse processes. Palpation and motion of the spine elicited

[2]Roentgenographic studies from the Department of Roentgenology, University of Michigan Medical School.

no pain or tenderness. Roentgenographic studies of the lumbo-sacral spine (Fig. 3) showed a lesion involving the second, third, fourth and fifth lumbar and the first sacral segments. It was characterized by in-

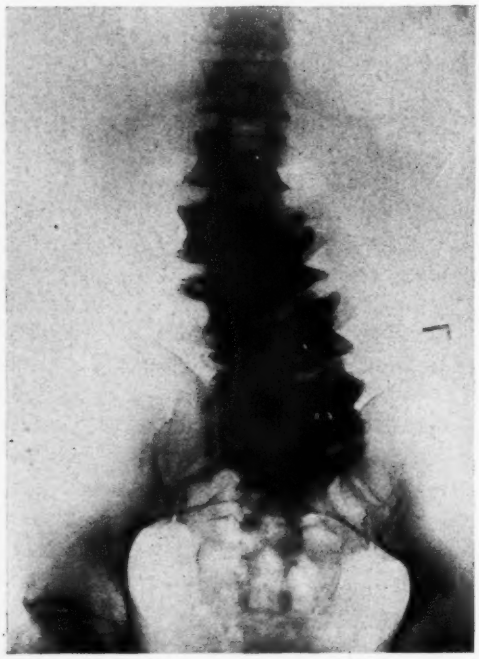

Fig. 3. Case 2. Lumbo-sacral spine, showing a lesion involving the second, third, fourth and fifth lumbar and the first sacral segments.

creased density and some destruction, involving chiefly the second lumbar on the left and the last lumbar on the right. There was angulation at these points. There was no bony debris in the soft tissues.

Case 3. A male, aged forty-six, single, an iron miner by occupation, first entered the Clinic for Neurology in December, 1924, complaining of impaired vision and pains in the abdomen and legs. He said that he had had gonorrhea and a chancre twenty-three years before. In 1915 he began to have attacks of abdominal pain at irregular intervals, and seven years later was operated upon for "gall bladder disease and appendicitis" with no relief. Since 1915 he had also suffered from frontal headaches and failing vision. A few months before entrance to the clinic he had submitted to a nasal operation for the relief of these symptoms, but had experienced no improvement. At that time it was discovered that he had syphilis, and he was given ten intravenous and four intraspinal injections of salvarsan. Eight months before entrance he began to have sharp, shooting pains and numbness in the lower extremities. Examination showed the left pupil to be smaller than the right. Both were fixed to light but reacted well in accommodation. There was bilateral optic atrophy. Vision in the left eye was limited to light perception. Knee and Achilles jerks were absent and deep sensibility was impaired in the lower extremities. Wassermann reactions on the blood and spinal fluid were strongly positive for syphilis. The spinal fluid contained fifty-three cells per cubic millimeter and a heavy increase in albumin and globulin. Roentgenographic studies showed no gross pathology in the gastro-intestinal tract. He was treated with injections of mercury succinimid and potassium iodide by mouth.

In January, 1926, he returned to the clinic for re-examination. Findings at that time were essentially unchanged, with the exception of the spine, which showed a marked deformity. With the patient in the upright position there was marked flexion of the spine and undue prominence of the left lower thoracic cage. The upper trunk was apparently deviated to the left at the level of the third lumbar vertebra. The lower ribs on the right were well down in the pelvis. The right ilium protruded beyond the lateral wall of the thorax. On the left the ribs extended beyond the crest of the ilium and did not fall into the pelvis. Suspension of the patient by the shoulders corrected both the spinal and thoracic deformities. Forward bending also tended to correct the spinal deformity. The motility of the spine was not limited. Pain occur-

red only where the ribs impinged on the ilium. Roentgenographic studies (Fig. 4) showed destructive lesions, with bony proliferation at the articulation of the second and third lumbar vertebræ and at the junction of the fourth and fifth lumbar segments. There was displacement of the spine to the left at the level of the upper lesion.

Case 4. A male, fifty-eight years of age, formerly a bookkeeper by occupation, first entered the Clinic for Neurology of the University Hospital on March 21, 1923, complaining of inability to walk and incontinence of urine. His family history was of no significance. At nineteen years of age he had had a penile chancre of three weeks' duration. As a young man he had had malaria. In 1916 he had been given intensive intramuscular treatment for locomotor ataxia by Dr. C. D. Camp, of Ann Arbor. His present illness commenced in 1905 with burning along the lateral aspect of the feet. Four years later he began to have attacks of sharp, shooting pains in the lower extremities. These were followed by the development of a mild degree of ataxia and some disturbance of micturition. Six years before his admission to the hospital, following several falls to the ground while walking, he developed lesions of the left knee and right hip joints which made necessary the use of crutches.

Upon examination his pupils were found to be unequal, irregular and fixed to light. They reacted well in accommodation. The extra-ocular movements were normal. Hearing was markedly impaired in both ears. There was no paralysis of the face, jaw, tongue or soft palate. The tendon reflexes were normal in both upper extremities. Knee and ankle jerks were lost and plantar stimulation caused no response. Deep sensibility was impaired in the lower extremities. The gait and station could not be tested because of the patient's inability to stand or walk. There was increased mobility but no tenderness at the right hip and left knee joints. The Wassermann reaction was four plus on the blood and spinal fluid. The gold colloidal curve was 1222210000 and the mastic 332210. The spinal fluid

Fig. 4. Case 3. Destructive lesions, with bony proliferation at the articulation of the second and third lumbar vertebræ and at the junction of the fourth and fifth lumbar segments.

contained twenty-four cells per cubic millimeter and increased albumin and globulin. X-ray plates of the right hip and left knee, reviewed by Dr. P. M. Hickey, yielded no evidence conclusive of tabetic arthropathy. The patient developed an acute upper respiratory infection and because of it intensive anti-luetic treatment was held in abeyance. Following recovery from this latter condition he was discharged, with advice to take potassium iodide by mouth. In November, 1923, and again in March, 1925, he returned to the University Hospital, on each

occasion receiving six intramuscular injections of neo-trepol without improvement.

On March 30, 1926, he again returned to the hospital stating that he had been chairfast for the past year. He was still troubled by the burning in his feet, occasional darting pains in the lower extremities, and urinary incontinence. During the past year he had had numerous attacks of sharp precordial pain and of dyspnea. He said that three months before entrance his wife had noticed a small lump over his lower spine while bathing him. He himself had observed no spinal deformity before she had called his attention to it. The spinal lesion had given him no pain though it had doubled in size since it was first noted, he said.

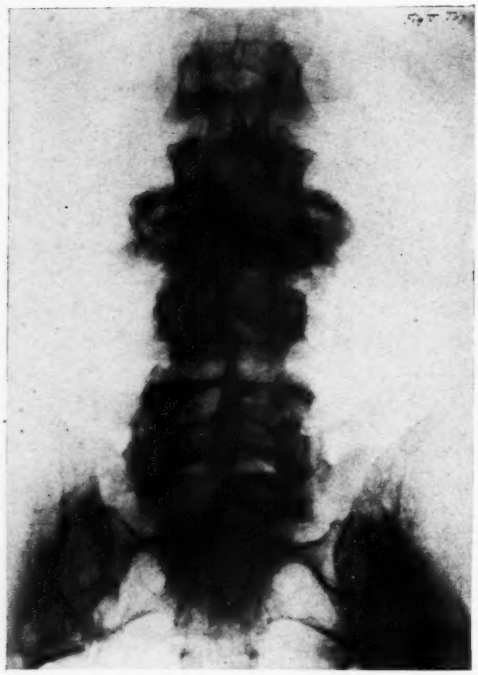

Fig. 5. Case 4. See text.

The neurological examination yielded essentially the same findings as those obtained upon previous entrances. Particular attention was directed to the patient's spine, which showed a small kyphos involving the middle lumbar vertebræ. The kyphos was about the size of a hen's egg and was not sharply angulated. Palpation and percussion elicited no tenderness. The condition led to no diminution of spinal motility and was associated with neither scoliosis nor muscle spasm. Examination of the heart showed signs indicative of aortitis and aortic regurgitation. The blood and spinal fluid Wassermann reactions were again four plus. The gold colloidal curve was 0011222110 and the mastic 123210. The spinal fluid contained three cells per cubic millimeter and a moderate increase in solids. X-ray examination of the lumbar spine (Figs. 5 and 6) showed almost complete destruction of the third lumbar vertebra, with extensive bony proliferation about the lesion. Plates of the right hip and left knee joints were pronounced diagnostic of tabetic arthropathy.

Fig. 6. Case 4. See text.

### COMMENT

The four cases reported are, we believe, undoubted cases of tabes dorsalis associated

with spinal osteo-arthropathy. Each gives a definite history of primary luetic infection and presents the cardinal signs and symptoms of tabes dorsalis. Positive serological reactions were obtained in Cases 1, 3 and 4, and although these were lacking in Case 2, yet in this latter the history and clinical examination allow no doubt as to the diagnosis of tabes dorsalis. Examination of the spine in each case disclosed signs held characteristic of tabetic spinal osteo-arthropathy: a deformity of the lumbar spine (the site of predilection of the condition), painlessness, increased mobility (decreased in Case 2), absence of tenderness and lack of muscle spasm. The roentgenographic findings were in all cases conclusive, showing destruction of bone and joint spaces occurring with bony proliferation.

In all four cases there are several noteworthy features to which we would call attention: (1) Males only were affected, a circumstance probably dependent upon the fact that tabes is more common in men. (2) The spinal lesion in each case followed late upon the original syphilitic infection, twenty-two years in Case 1, eighteen years in Case 2, twenty-three years in Case 3 and thirty-nine years in Case 4. (3) In no case was the spinal deformity first noticed by the patient. (4) In each instance the condition was evident upon physical examination of the spine. (5) The arthropathy developed in all four cases despite active anti-luetic therapy. (6) In no case was there a history of direct trauma to the spine. (7) In Case 4 the spinal osteo-arthropathy was associated with arthropathy of the right hip and left knee joints—an example of multiple arthropathies.

## CONCLUSIONS

1. Tabetic spinal osteo-arthropathy probably occurs less rarely than is generally supposed.

2. Its detection depends upon physical examination of the spine, not upon the patient's subjective complaints.

3. It occurs independently of trauma to the spine and in spite of anti-luetic treatment.

4. It follows late upon the initial syphilitic infection, occurs more commonly in males, and may be associated with arthropathy elsewhere.

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# X-RAY THERAPY IN FUNCTIONAL THYROID DISEASE[1]

By ARTHUR W. ERSKINE, M.D., CEDAR RAPIDS, IOWA

IF the disease, which, in its variations and stages, we call hyperthyroidism, toxic adenoma and exophthalmic goiter, is a manifestation of an excessive or altered secretion of the thyroid gland, we may expect methods which inhibit or destroy function to be curative. Of such methods, the two outstanding ones, surgery and radiation, have much in common. Both are destructive. Surgery lessens or abolishes function by one, two or three operations, while X-ray treatment does the same thing in from six to twelve destructive procedures which, because of their effects, may well be thought of as operations. The results obtained by skillful surgical treatment and careful and patient X-ray treatment are approximately the same, as has been shown by the publication of numerous reliable data. Either method, used with the same degree of skill, will cure from 60 to 70 per cent of all cases and produce satisfactory improvement in from 20 to 30 per cent more. The great and important difference between the two methods is in the matter of time. Surgery is quick, but has a definite, though small, mortality rate. Radiation, although comparatively safe, is slow, at least two months, on the average, being required before improvement is evident. The purpose of this paper is not to proselyte for either method to the exclusion of the other, but rather, by consideration of their essential differences, to point out some conditions which should influence the physician in his choice of the method most suitable for his patient.

X-ray treatment is contra-indicated when the disease is progressing so rapidly that it is obvious that permanent damage will be done in two months, and for such cases surgery should be advised.

There is a large group of patients who, for economical and other reasons, are extremely anxious to be relieved of their symptoms in the shortest possible time. They should receive the benefit of operation. In the same group may be included those who, perhaps because of their disease, are highly emotional and unstable and are unfitted temperamentally to undergo the long régime which should accompany treatment by radiation.

Patients who prefer surgery and fear or distrust X-rays should be referred to the surgeon. It is not advisable to make a great effort to gain the confidence of these patients and to persuade them to submit to X-ray treatment, because too many of them will abandon the treatment before they have had time to receive any benefit or will fail to continue treatment long enough to be as completely restored to health as they would have been had the gland been removed.

On the other hand, substernal goiter is a positive indication for X-ray treatment. Surgical removal of substernal goiter is a difficult and dangerous operation and is not justified unless X-ray treatment has been ineffective.

Patients who are poor surgical risks because of constitutional disease or because of advanced thyroid disease should be treated by radiation unless the chances of death from thyroid disease inside of two months seem greater than the operative risk.

Surgical failures and recurrences after operation may well be treated by radiation. In this group one should treat the region of the thymus gland as well as the thyroid.

For patients with mild symptoms who are under control and wish to avoid an operation with its attendant danger, loss of time and expense, X-ray treatment is the method of choice.

[1]Read before the Radiological Society of North America, at Milwaukee, Nov. 29–Dec. 4, 1926.

There remains a rather large group of patients in whom positive indications or contra-indications for either surgical or X-ray treatment are lacking. They are in no immediate danger of death and have enough stability, fortitude and patience to be able to face with equanimity either the risk of operation or the tedium of treatment. It seems proper to me to permit them to make their own choice. The advantages and disadvantages of each method should be carefully and truthfully explained. The roentgenologist who values his reputation and results will accept only those who prefer to be treated by radiation. He will attempt to gain and retain the confidence of his patients, and to build up their morale by painstaking attention to the details of their clinical management. X-ray treatment of hyperthyroidism and exophthalmic goiter is major radiological work and should be undertaken only by those who are well trained clinicians in addition to being expert in the technical details of their own art.

It is almost impossible to over-emphasize the importance of rest and the elimination of focal infection in the management of functional thyroid disease. It is sometimes a temptation, because many of our patients are ambulatory, to permit them to retain infected teeth or tonsils or to attempt to do too much work or engage in too many social activities. I believe that infection and overexertion often retard or diminish the degree of recovery.

Since I have come to regard an X-ray treatment as a minor operation I have tried to prepare the patients by giving them full doses of iodin (15 to 60 drops a day of Lugol's solution) for a week before each treatment. Unpleasant reactions have seemed to be less frequent and less severe, and I believe the method has some value.

The dosage recommended by most writers seems to be considerably less than I have had to employ. It has been my custom to give about 300 electrostatic units (measured in air) of such a quality that half the radiation is absorbed by 3.25 centimeters of water.[2] This dose is applied to a single large area, which includes the thyroid and thymus. It is repeated ten days or two weeks later, and if it be well borne the dose is increased to 450 units of the same quality, which is given every two, three or four weeks as the needs of the case seem to require.[3]

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2The physical factors are as follows: 135 K.V., 5 ma., 0.25 mm. Cu. plus 1.0 mm. Al., 20 minutes, 40 cm. A.S.D., for the first two treatments and 30 cm. for the later ones.

3Discussions of papers read at the Annual Meeting will be published in a later issue of RADIOLOGY.

# THE RELATIVE SENSITIVITY OF THE KIDNEY TO IRRADIATION[1]

By H. P. DOUB, M.D., A. BOLLIGER, Ph.D., and F. W. HARTMAN, M.D.
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DETROIT

THE successful application of radiotherapy is due in large measure to the broad foundation laid in the exhaustive study of the immediate metabolic reaction and the tissue changes produced in man and the experimental animal. The literature on the immediate response of the body as regards metabolism, normal tissue and tumors is abundant, but that relating to chronic or terminal changes is far from being comprehensive.

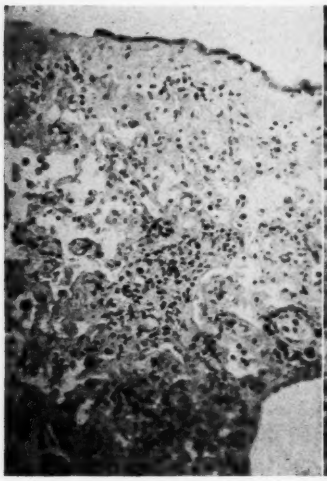

Fig. 1. Photomicrograph of lung, showing thickened pleura and diffuse fibrosis.

Fig. 2. Photomicrograph of liver, showing increase of fibrous tissue at the periphery of the lobule.

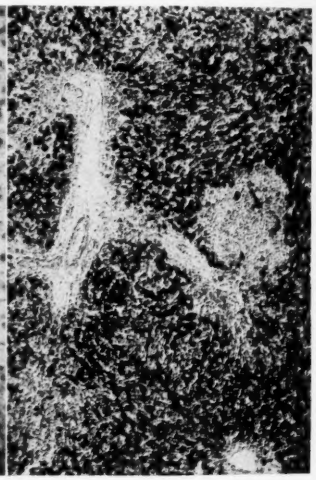

Fig. 3. Photomicrograph of liver stained with Sudan III; all cells filled with fat and area of focal necrosis.

In recently reported experimental work on dogs it was demonstrated that a fatal nephritis could be readily produced by the application of hard X-rays through the body wall. This was accomplished both with single massive doses and with repeated smaller doses. In the first experiments large perforating ulcers were produced in the abdominal wall and the animals were lost from extensive destruction of the intestine, but the technic has been developed to the point where little or no hair is lost and only an occasional scar or ulcer of the intestine is found. However, when an area 10 cm. square over one or both sides was irradiated the corresponding adrenal and ovary were always within range, and portions of the spleen, liver, pancreas and intestine were in the area when the liver and heart were exposed. From the animals lost in the early part of the work three to five days after irradiation the acute changes were in order of severity as follows: (1) intestine, (2) adrenal, (3) kidney, (4) spleen, (5) liver, (6) ovary and (7) pan-

[1]Presented before the Radiological Society of North America, at Milwaukee, Nov. 29–Dec. 4, 1926.

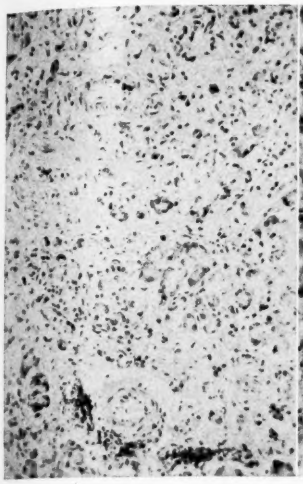

Fig. 4. Photomicrograph of pancreas; diffuse fibrosis and sclerosis of blood vessel.

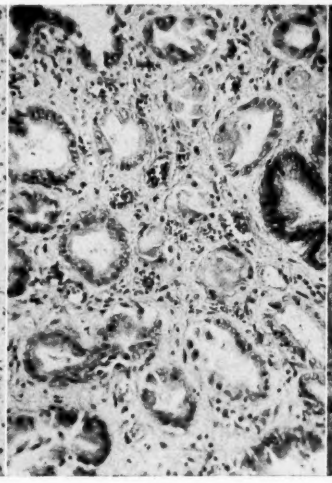

Fig. 5. Photomicrograph of stomach; hyperplasia of mucosa near pylorus.

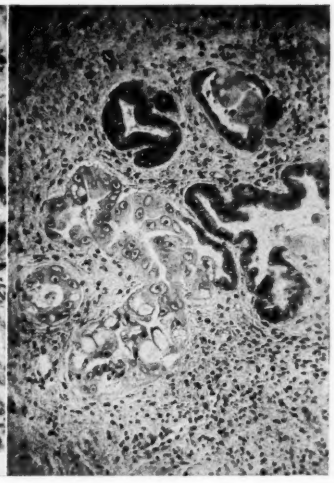

Fig. 6. Photomicrograph of intestine; fibrosis, with few remaining glands; one stains poorly because of recent irradiation.

creas. These acute changes have been adequately described.

In this work interest has been centered on the chronic nephritis produced and the resulting renal insufficiency. It is the object of this paper to determine the relative susceptibility of the kidney and to evaluate the dangers of the clinical application of deep therapy over the kidney area. The experiments were all done on dogs, and 200 kilovolts, 30 milliamperes, with filtration of 1 mm. copper and 1 mm. aluminum at 50 cm. skin distance was used. Up to the present time some seventy-five animals have been used and the changes described resulted from irradiation through the abdominal or chest wall either in the kidney work already reported or in one of the two series of experiments now in progress, that is, irradiation over the liver and over the heart, both of which will be reported in detail at a later date.

The chronic lung lesions produced by deep X-ray have been described, both in the experimental animal and in patients, by Davis (1), Groover and Christie (2), Evans and Leucutia (3) and others. The findings reported are in agreement. Our observations have added nothing except to demonstrate the relative high resistance of the lung in a large series of animals. Weekly applications over the chest for periods of from 15 to 30 minutes during two to five months produced extensive fibrosis only in the pleura or periphery of the lobes. No infection was noted in this series (Fig. 1).

Although the acute changes in the liver from irradiation are well understood, the chronic changes are rarely observed, for one of two reasons: (1) either the subject succumbs to the massive destruction of a large dosage, or (2) the regeneration after smaller doses is so rapid and complete as to leave little or no residual.

With the hope of preventing acute losses and still overcoming regeneration, weekly doses were again applied, but of the eight animals in this series only three showed reduction in the size of the liver. Here the organ was reduced to about one-half the estimated weight and showed extensive fatty infiltration, areas of focal necrosis,

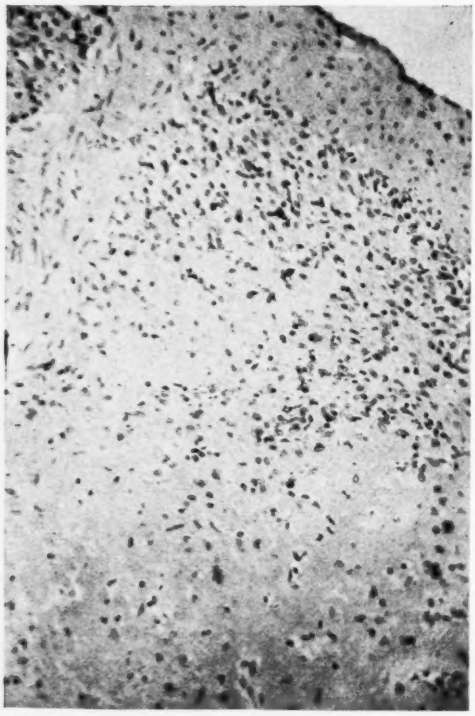

Fig. 7. Photomicrograph of spleen; thickened capsule and trabeculæ, with area of hyalinization.

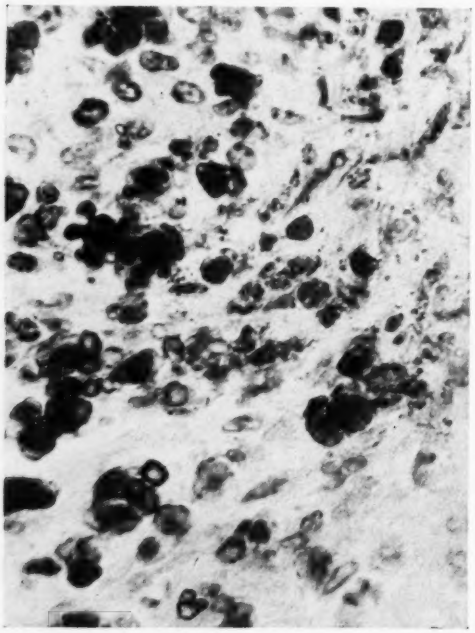

Fig. 8. Photomicrograph of spleen; marked increase of intra- and extracellular pigment.

some increase of fibrous tissue at the periphery of the lobule, loss of the orderly cell arrangement and extensive regeneration. Failure thus far to produce any extensive cirrhosis is interpreted as due to the absence of fibrous tissue overgrowth and places the liver in the position of being one of the most susceptible organs to acute destruction and most resistant to permanent damage (Figs. 2 and 3).

The effect of hard X-rays upon the pancreas has been studied recently by Orndoff, Farrell and Ivy (4), with particular attention to glandular activity. They report also diffuse fibrosis of the pancreas after exposure to one human erythema dose. Similar fibrosis has been observed only twice in our entire series and even in these the islets were remarkably well preserved. Repeated sugar tolerance tests throughout the period of observation on these animals failed to show any decided abnormality of the sugar metabolism (Fig. 4).

The chronic lesions of the stomach and intestine have received more attention than those of other organs, especially as regards patients, and also in the experimental animal through the work of Warren and Whipple (5); Martin and Rogers (6); Ivy, McCarthy and Orndoff (7) and others. The group of experiments here reported demonstrates how well animals tolerate the destruction of the epithelium, fibrosis of the same and the deep indurated ulcers which were found at autopsy in a third of the animals. The resistance of the mucosa of the duodenum is emphasized in the animals receiving weekly doses; where extensive fibrosis and occurred, a few glands were swollen and stained poorly from the recent dosage, and a few glands remained intact. In a single animal metaplasia of the gastric mucosa to squamous epithelium resulted (Figs. 5 and 6).

The spleen was within the irradiated area in this series whenever the left kidney was

exposed. As contrasted with the acute changes described, affecting principally the lymphoid tissue, the chronic changes involved the capsule, trabeculæ and blood vessels for the most part. Usually the size was not greatly reduced, but on section it was found to be firmer and more fibrous than the normal organ. Microscopically the capsule and trabeculæ were larger, the blood vessels thick walled, and in some cases had undergone complete endarteritis. The follicles were fewer in number and contained a smaller number of cells than usual. Scattered throughout, much yellowish-brown pigment, both intra- and extracellular, was found. In three animals extensive hyalinization of the splenic pulp was observed (Figs. 7 and 8).

The ovary of the female dog cannot be avoided in radiating the kidney through the abdominal wall. After periods of from two to thirteen months these ovaries have been removed and examined. They were reduced from one-half to one-third of the normal size and contained several corpora lutea usually. Histologically, the follicles are reduced from countless numbers in various stages of development to a few scattered, atypical, poorly staining ones (Figs. 9 and 10). In spite of these anatomical changes the animals gave evidence of ovarian function and have produced large litters of pups after exposure to enough deep X-ray to result in a fatal renal insufficiency.

Martin, Fisher and Rogers (8) have reported extensive fibrosis of the adrenal, with complete disappearance of the medullary portion after direct irradiation. In an earlier communication, the chronic changes in the adrenal were found to consist of thickening of the capsule and an increase of the lipoid content of the zona glomerulosa. These changes were not associated with any demonstrable adrenal insufficiency. Here, as in the liver, the marked acute lesions failed to result in permanent damage be-

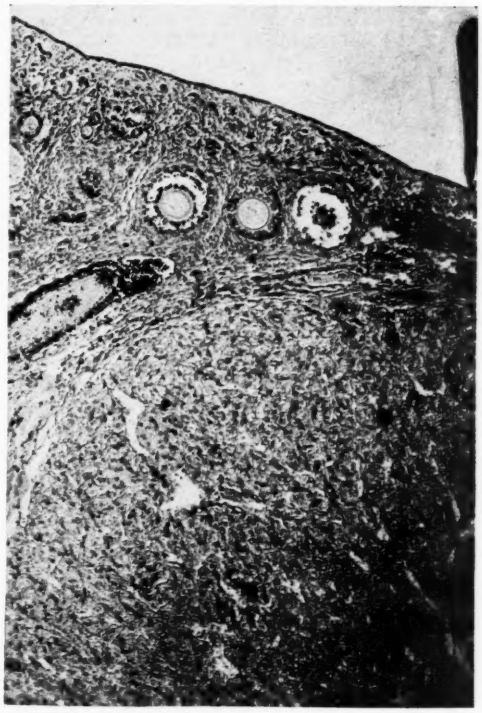

Fig. 9. Photomicrograph of ovary; decrease in number of follicles.

Fig. 10. Photomicrograph of ovary; atrophic follicles.

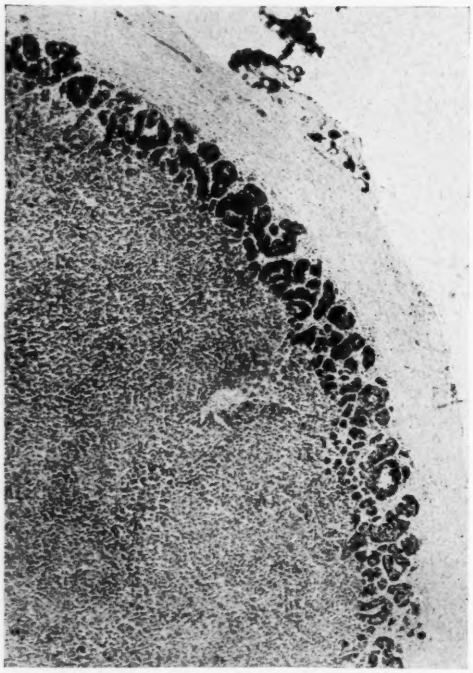

Fig. 11. Photomicrograph of adrenal; Sudan III stain, showing increase of lipoids in zona glomerulosa.

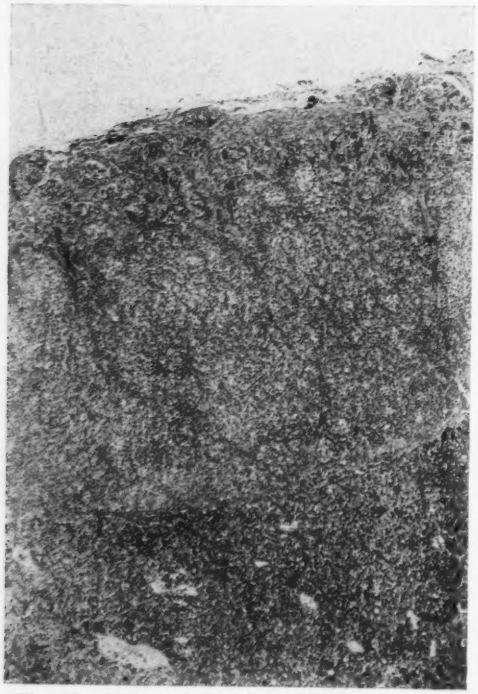

Fig. 12. Photomicrograph of adrenal; thickened capsule, with fibrosis of cortex.

cause of the regenerative power and slight fibrous tissue production (Figs. 11 and 12).

Chronic diffuse nephritis of the combined interstitial and vascular type as produced by irradiation of the kidney through the abdominal wall has been uniformly obtained, often with relatively small single applications. This lesion is progressive in proportion to the initial damage, as demonstrated in functional and histological studies. The progressive course is dependent upon the initial destruction of the epithelium, absence of regeneration, prompt and extensive fibrous replacement and sclerosis of blood vessels and glomeruli. As a result of the lack of this repair process the kidney is perhaps more susceptible to complete anatomical and functional change than any other organ considered (Figs. 13 and 14).

The bearing of the demonstrated susceptibility of the kidney to irreparable damage from the clinical application of deep therapy to the renal area has been a constant question since the early stages of this work, and leads to the report of two cases seen in our clinic, along with data about similar cases obtained through the return of questionnaires sent to over four hundred roentgenologists and pathologists.

Of the two cases personally observed, C. B., white, male, age 45, had a trace of albumin in the urine and a phthalein output of only 43 per cent at the beginning of treatment, but no other symptoms of nephritis. After 60 hours of X-ray for lymphosarcoma the urine was of constantly low specific gravity and contained a moderate amount of albumin, with numerous hyaline casts. Blood urea nitrogen rose from 12 to 30 mgs. per 100 c.c. of blood and the systolic blood pressure rose from 140/70 to 195/105.

The second case, Mrs. O. C., white, female, age 60, showed a trace of albumin in the urine, phthalein of 45 per cent in two hours, and blood pressure of 120/80 at the

time deep therapy was instituted after a carcinoma of the pylorus had been removed by operation. Ten months after the completion of the first course of deep therapy over the upper abdomen the urine showed a moderate amount of albumin and many coarsely granular casts. The phthalein output was zero. Blood non-protein nitrogen was 150 mgs., urea nitrogen 74.2 mgs. and uric acid 7.15 mgs. per 100 c.c. of blood. The blood pressure was as high as 230/140. Patient died at this time in uremic coma.

In the statistical study 208 replies were received, 65 of the 150 sent to roentgenologists and 143 of the 350 sent to pathologists. Two of the 65 answers from roentgenologists were positive, but one case reported was not proven. Fourteen of the replies of the 143 pathologists answering were positive. With the two cases personally observed there were eighteen cases of nephritis developing or becoming clinically recognizable during or after a course of deep therapy. Although no record of the area treated could be obtained in the questionnaire data, it is significant that the two cases seen in our clinic were treated directly over the kidney area. This confirms our experimental data that nephritis of the type described is produced only by direct irradiation.

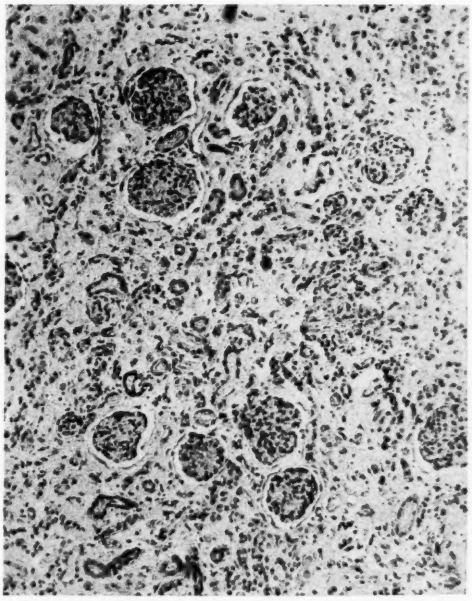

Fig. 13. Photomicrograph of kidney; replacement of tubules by fibrous tissue and hyalinization of the glomerular tufts.

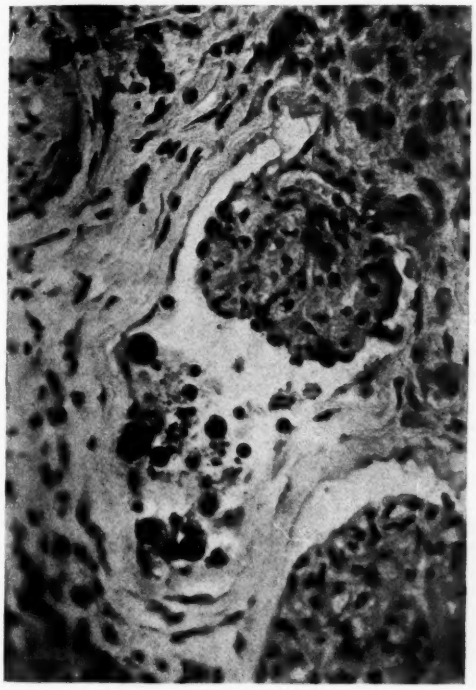

Fig. 14. Photomicrograph (high power) of kidney; hyalinization of the glomerular tuft, dilatation of the capsular space, and thickening of Bowman's capsule.

## SUMMARY

1. The kidney is the most susceptible organ considered as far as anatomical changes and loss of function are concerned.

2. The susceptibility of other organs to chronic changes is as follows: Intestine, stomach, pancreas, ovary, spleen, lung, adrenal and liver.

3. Direct irradiation of the kidney is shown to produce nephritis, with hypertension in clinical cases as well as in the experimental animal.

4. Such direct irradiation should be avoided, especially in the young individual.[1]

[1]Discussions of papers read at the Annual Meeting will be published in later issues of RADIOLOGY.

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# THE ANATOMY OF THE NORMAL SMALL INTESTINE AS OBSERVED ROENTGENOGRAPHICALLY[1]

By RUSSELL W. MORSE, M.D., and LEWIS GREGORY COLE, M.D., New York

IN 1921 R. Walter Mills reported the results of a roentgenographic study of "small intestinal states" and in his report called attention to the fact that very little effort had been expended in investigating the normal and abnormal conditions of the small intestine by means of the X-ray. He discussed at length a new hypothesis of the transmission of tension in the gastro-intestinal tract. He did not, however, discuss the detailed anatomy of the small intestine, or offer any plan of procedure by which the small intestine could be studied in detail during the routine roentgenographic examination of the gastro-intestinal tract.

We believed that a procedure of roentgenographic examination could be devised which would show the anatomical details of the small intestine as clearly as we have shown those of the stomach, cap and colon. This would enable us—

(1) To recognize the roentgenographic appearance of the normal small intestine, together with those variations in appearance which come within so-called normal limits;

(2) To study the motor phenomena of the small intestine;

(3) To recognize and identify pathological conditions involving the small intestine and functional derangements of the small intestine.

This report will describe a method of roentgenographic examination by which it is possible to make visible the small intestine, and will describe the roentgenographic appearance of the small intestine and those normal variations in appearance which are most often encountered.

[1]Read before the Radiological Society of North America, at Milwaukee, Nov. 29–Dec. 4, inclusive, 1926.

## METHODS OF EXAMINATION

The following conditions must be fulfilled in order to secure roentgenographic visibilization of the small intestine:

1. An opaque medium must be used of such composition and consistency that it will pass out of the stomach at a fairly rapid and uniform rate of speed.

2. The medium must be of sufficient consistency to pass evenly — and preferably fairly slowly — through the intestine.

3. Roentgenographic examinations must be made at intervals which will show the various parts of the small intestine when they are best filled.

The opaque medium which has proved most successful in use is a moderately thick paste of barium sulphate and water. Thoroughly mix eight ounces by weight of barium sulphate with five ounces of water. This makes a mixture of seven ounces volume: more than this amount is not necessary. Avoid over-distention of the stomach, as this not only gives a less satisfactory visibilization of the stomach and cap, but also causes the stomach to obscure an unnecessary amount of the upper intestine.

This study is based on the routine roentgen examination of the gastro-intestinal tract of patients at the office. The examination for the small intestine has varied to a certain extent as the experimental work has progressed. The following is the most satisfactory routine procedure.

The serial roentgenographic examination of the stomach is made immediately after ingestion of the meal. The roentgenograms in the erect position are made first and the time interval necessary to localize the stomach is usually sufficient to obtain filling of the cap and duodenum. The roentgenograms of the stomach in the prone and

prone oblique positions are then made in sequence. The duodenum is shown in detail in the serial roentgenograms made of the stomach.

Following this, a 14 × 17 roentgenogram is made in the prone position. This follows usually about a half-hour after ingestion of the meal and is the first step in the routine study of the small intestine. Further roentgenographic examination is made two, four and six hours after the ingestion of the meal. At the six-hour period most of the meal is usually in the colon, only the distal part of the small intestine remaining filled.

The time interval between the successive roentgenograms may be varied according to the rate of emptying of the stomach and the rapidity of passage of the meal through the intestine. Roentgenograms made every ten to twenty minutes will usually show the progress of the head of the column from one loop of the intestine to the next.

Examination is routinely made only with the patient in the prone posture. Comparative roentgenograms were made in both the prone and erect positions and it was found—

(1) That the position of the small intestine varied but little in the two postures;

(2) That the loops of the small intestine were more discretely shown in the prone position;

(3) That there is no appreciable distortion of the small intestine in the prone position.

The outline of the roentgen shadow of the opaque medium in the intestinal tract establishes in one or more planes the contour of the inside of the intestine. This directly reveals—

(1) The contour of the inner surface;

(2) The caliber of the lumen;

(3) The position of the intestine.

The inner surface of the mucosa, however, is modified in character by the changes in the muscular wall of the intestine and also by pressure on the intestine from without. The roentgenographic outline of the inner wall of the intestine is therefore an expression not only of the surface of the mucosa but also of the muscular coats of the intestine and of certain conditions existing outside of the intestine itself.

### ANATOMICAL STUDY

There are two main divisions of the small intestine:

1. The duodenum, which is largely retroperitoneal in position and relatively fixed.

2. The mesenteric small intestine which is interaperitoneal and, because of its mesentery, relatively movable. On the basis of relative differences in the mucosa the mesenteric small intestine has been further divided into the jejunum, which is proximal, and the ileum, which is distal. Although the difference in the mucosa of the proximal part of the small intestine and the distal part of the small intestine is marked, there is no abrupt dividing line and the transition from characteristic jejunum to characteristic ileum is gradual.

This division of the mesenteric small intestine into jejunum and ileum does not apparently have a good anatomical basis. Most anatomists prefer to speak of this part of the small intestine as a unit, calling it either the jejunoileum or, preferably, the mesenteric small intestine.

Cole has previously stated that the cap should be considered as part of the stomach and not part of the duodenum. It is developed from the fore-gut as is the stomach, while the duodenum and mesenteric small intestine are developed from the mid-gut.

C. M. Jackson, in his section on the digestive system in Morris's "Human Anatomy," states as follows: "Even in an embryo of 19 mm., while the intestine is still in the umbilical celom, Mall described six primary coils of the small intestine which could still be recognized after the return of the intestine to the general body cavity, and could usually be identified even in the adult. In the adult, as also through the various

stages of development, Loop One forms the duodenum."

From our findings in the study, so far, we believe that the groups of intestinal coils developing from these six primary coils can be recognized roentgenographically. The first loop is the duodenum and should be known under that name.

The second, third, fourth, fifth and sixth groups of coils are the mesenteric small intestine. We believe that these several groups of coils can be recognized roentgenographically and that any roentgenological division of the mesenteric small intestine should be on this basis of development.

### DUODENUM

We consider that the duodenum begins at the first crescentic or annular fold distal to the pyloric valve, and extends to the duodeno-jejunal flexure. The duodenum is relatively fixed in position in the form of a loop, the opening of the loop facing to the left and superiorly. The concavity of the loop encircles the head of the pancreas and corresponds in size to it.

There are several normal shapes of the loop of the duodenum. Depending upon the relative position and angulation of the superior, descending and inferior parts, the duodenum may be shaped like the capital letters "C," "V" or "U," or may be almost rectangular in shape.

The superior or first part of the duodenum is not retroperitoneal and is usually short. It is best visualized in the prone oblique posture. This superior part of the duodenum passes posteriorly and usually superiorly and to the right from the cap. Occasionally the superior duodenum may pass to the left or directly down behind the cap.

The angle at the inferior margin of the junction between the cap and superior duodenum may be obtuse or acute. The more the stomach is raised upward and forward by the other abdominal contents, the more obtuse is the angle. In marked elevation of the stomach or in the short typical hypertonic type of stomach, the cap may point inferiorly into the superior duodenum. This is inversion of the cap.

The superior duodenum may be long and occasionally forms a loop inferiorly, the cap and the upper end of the descending duodenum forming the two points of suspension. The folds of the mucosa within this loop are usually low in height and few in number.

The descending and inferior parts of the duodenum are relatively fixed in position. This fixation is, however, more relative than absolute, and the position and form of the duodenum usually differ in the prone and erect postures of the individual.

The anterior and lateral walls of the duodenum are covered by peritoneum, protrude into the peritoneal cavity and are relatively free. For this reason the contour will vary considerably with varying degrees of filling.

### DUODENO-JEJUNAL FLEXURE

This is usually the highest fixed point of the small intestine. The inferior duodenum usually ascends to the flexure. The flexure is suspended by the fibro-muscular ligament of Treitz which passes down behind the pancreas from the lumbar part of the diaphragm.

The intestine is only occasionally held to a point at the duodeno-jejunal flexure. Usually it makes a moderate curve on itself, and less commonly the curve is very wide. The curve at the flexure is usually from posterior to anterior. For this reason in many individuals the angle of the curve can be appreciated only when it is viewed in the oblique or lateral direction.

From the duodeno-jejunal flexure the intestine passes forward and usually inferiorly toward either the right or left side. This first loop of the mesenteric small intestine is

more commonly directed inferiorly, or inferiorly to the left, than it is toward the right side.

Occasionally the intestine, a short distance distal to the flexure, is caught up at a second point of fixation, forming a short loop.

### MESENTERIC SMALL INTESTINE

The second group of coils, which forms the first part of the mesenteric small intestine, is usually located in the left hypochondrium and the loops may ascend above the level of the duodeno-jejunal flexure. The third group of coils is usually located in the left lumbar region and the loops may descend below the plane through the superior iliac spines. Almost uniformly, both of these groups extend slightly beyond the right side of the spine. It is uncommon, however, to observe several loops of these groups in the right hypochondriac and right lumbar regions. The various loops of these groups are usually quite discrete, particularly when they are widely distributed in the abdomen. Only when they are confined within a relatively small area are they massed together so that the individual loops cannot be recognized. The fourth group of coils is usually found in the umbilical and upper hypogastric regions. The fifth group of coils is usually observed in the right lumbar region, and the sixth group of coils is usually located in the right iliac fossa and the false pelvis, or lower hypogastric region. Distinct visualization of the separate loops of the fourth, fifth and sixth groups largely depends upon their position in the abdomen. If the loops are mostly out of the pelvis, they can be individually recognized. When the loops are grouped together in the pelvis they may be so massed together that it is impossible to recognize their outlines. Upward displacement of the intestine by a filled urinary bladder also tends to mass the loops together. This tendency in many individuals for the groups of coils to be massed together is the most serious obstacle we have encountered in attempting to accurately visualize the small intestine.

### FOLDS OF THE MUCOSA

The surface of the mucosa of the small intestine is characterized by the presence of numerous circular, spiral and crescentic folds. These folds, which are most commonly called the plicæ circulares, are found throughout the small intestine but are most numerous and of greater height in the duodenum and first loops of the mesenteric small intestine. They diminish somewhat in height and number through the fourth and fifth groups of coils. In the sixth group of coils they are short and less numerous and may be absent in the terminal part.

The folds are possibly of two types:

1. The permanent folds, that is, those that persist during distention of the intestine and persist in the anatomical specimen. These are a duplication of the mucosa and muscularis mucosa, bound together by the submucosa.

2. Those folds which are due to temporary contraction of the muscularis mucosa. Forssell has called attention to the varying form of the folds of the duodenum and ascribes this to varying contraction of the muscularis mucosa. From our findings we are unable to confirm or disprove the presence of folds of this type.

As observed in the roentgenogram these folds of the mucosa show the following characteristics:

1. With moderate filling of the intestine the folds project into the barium column, either at right angles or diagonally to the long axis of the intestine. They may point either proximally or distally. Usually they point distally in the direction of flow of the intestinal contents, apparently due to pressure on the folds by the intestinal content as it is moved distally.

2. In the distal part of the duodenum

and the upper mesenteric small intestine the folds may equal in height one-third the diameter of the distended intestine.

3. The folds diminish in average height progressively from the proximal to the distal portion of the intestine.

4. At any specific level of the intestine the folds are irregular in height; a very short fold may be next to a very high fold.

5. With only partial filling of the intestine the folds are in apposition across the lumen and this gives rise to the characteristic segmented and flaky distribution of the barium. In the duodenum, particularly, the barium may have a markedly fenestrated arrangement.

6. Folds of the mucosa are almost constantly found in the sixth group of coils to within an inch or so of the ileocecal valve.

7. Within the limits of a peristaltic wave of contraction the transverse folds lose their identity and the mucosa is folded in the longitudinal direction.

### CALIBER OF THE LUMEN OF THE SMALL INTESTINE

In the living subject the intestine is normally in a state of tonic contraction; it is contracted on itself or its contents. For this reason the caliber of the lumen of any section of the small intestine will depend largely on the degree of filling or distention. Certain normal variations in the rapidity of emptying of the stomach and the rapidity of passage of the meal through the small intestine will, therefore, modify the distribution of the meal and the appearance of the intestine.

1. Rapid uniform emptying of the stomach will give a large caliber to the intestine throughout the entire length in which the meal is present.

2. With slow or moderate uniform emptying of the stomach the caliber of the lumen of the intestine will be small or moderate, if the passage of the meal through the intestine keeps pace with the emptying of the stomach. If the passage of the meal through the intestine is more rapid than the entrance of the meal into the intestine, the caliber will be small, but usually uniform.

If the stomach empties itself intermittently, the distribution of the meal and the caliber of the small intestine will be irregular.

### ILEOCECAL VALVE

The most apt description of the roentgenographic appearance of the ileocecal valve is that used by Cole many years ago. He said, "The small intestine protrudes into the cecum at the ileocecal valve like the head of a cobra that is standing on its tail."

### SUMMARY

We have described a procedure of roentgenographic examination by which it is possible to visualize the anatomical details of the small intestine as clearly as we have shown the stomach, cap and colon, and have described the appearance of the normal small intestine as it is observed roentgenographically. During this study we have made other observations, but in this report have tried to limit ourselves to these two phases of the subject.

# EDITORIAL

M. J. Hubeny, M.D. . . . . Editor
Benjamin H. Orndoff, M.D. } . Associate Editors
John D. Camp, M.D. }

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## MANY ROENTGENOLOGISTS ARE OVERLOOKING A GREAT OPPORTUNITY

The X-ray is almost universally beneficial in the treatment of infection. This does not imply that it is the only agent required for any specific infection: it simply means that all and more of the benefits derived from the old poultice can be scientifically secured by the proper application of the ray. Compare the mess and trouble of keeping up hot applications night and day until an infection is ripe, with a single exposure of the ray, and you can see of what a boon you rob humanity by not teaching and advancing this use of the ray. Further, there are many cases which the poultice will not reach, such as furuncles and maxillary sinus infections. Also consider the damage done to the skin by long application of the poultice, compared with the wonderful cosmetic effects following irradiation.

While roentgenologists are fighting the scourges of our time, such as cancer and tuberculosis, it is neither wise nor scientific to overlook the great service which may be rendered by the proper attention to these minor but sometimes virulent infections. It is assumed that all radiologists are masters of the ray they employ. Given this, there are two obstacles which must be overcome before this service can be rendered. The medical profession must be made to understand the value, the limitation and the danger of the ray, and the roentgenologist must understand the many and varied manifestations of infection. X-ray machines adorn the offices of almost all dermatologists. I have found very few of them who understand fully the limitations or the values of the ray. On the other hand, many roentgenologists are found treating lesions, the etiology, diagnosis, prognosis and accepted treatment of which they do not fully understand.

Neither of these conditions is good for the patient nor the profession.

The answer is: knowledge and understanding. The application of this answer is an entirely different matter.

Infection attacks so many systems of the body that every medical specialty is called upon for its eradication. Think of the field that the radiologist must master if he tries to work alone, and also realize how many members of the profession he would alienate. He would certainly lose most of his diagnostic work. Co-operation, education and understanding are the only avenues to success.

This is an individual problem for each man to solve for his community. Each man must meet and master the conditions as he finds them.

We suggest that each of our members make a careful study of infections and of his local conditions. Then he must consult systematically one good man in each specialty and personally carry the gospel to the individual. The true gospel is that the ray is an adjunct and not the whole treatment, and to secure the best results it must be adequately administered with full understanding. This gospel can be preached best by those who learn from the men to whom they preach.

Any well qualified man can greatly increase his scope if he will follow these suggestions, and he will also render a service to

his community. We hope that such effort will help to keep the therapeutic ray in the hands of men well qualified to administer it.

KENNON DUNHAM, M.D.

## THE SCIENTIFIC EXHIBIT

To those who have long had the best interests of the Society at heart the Scientific Exhibit at the Milwaukee meeting was intensely gratifying. Never before in the annals of roentgen societies has such a collection of interesting material been assembled for study. The bulk of the credit for this must go to the members of the local committee; the perfect arrangements for the display of this material added materially to the attraction and to the interest of the members.

Commencing early, under the leadership of the late C. W. Geyer, the membership of the Society was thoroughly canvassed for material, the co-operation of the State University, the state, county and city organizations secured, and as material was offered facilities for its display were created. It is worthy of mention that the display boxes were made by the members themselves with the generous assistance of the technicians, and local representatives of commercial concerns, while the lighting was contributed by the representatives of the Cooper-Hewitt Electrical Company.

The net result of the energy and influence of these committee members was an exhibition dedicated to the memory of Sandborn, Carman, and Geyer, in every respect a magnificent and fitting tribute of which our Society may well be proud.

A new note of interest was injected into the Scientific Exhibit in the display by many of the members of the material from which their essays were drawn. It allowed many to study carefully points that were impossible of demonstration in the short time allotted to the paper on the program and also to elucidation of points that might have been obscure to the individual at the time of presentation. This is a feature that might well be noted and encouraged by the local committees of future meetings.

There were, in all, over fifty contributors, so that it will be impossible to more than mention the various exhibits and briefly outline their character.

In a series of photographs, charts, and gross pathological specimens, Doub, Hartman and Bolliger, of the Henry Ford Hospital, Detroit, demonstrated the chronic tissue changes following radiation. Proetz and Ernst, of St. Louis, illustrated their paper on the displacement method of sinus diagnosis with iodized oils by a series of photographs and prints. Young and Cooper, of Scottsbluff, Nebraska, presented a most interesting exhibit of films and gross specimens, with charts covering their study in paleopathology. Burrows, Jorstad and Ernst, of the Barnard Free Skin and Cancer Hospital, St. Louis, by charts, photomicrographs and appended descriptions exemplified their paper on studies on the effect of graded doses of X-rays on animals fed on various dietaries. Martin, of Dallas, Texas, showed photographs of patients with skin malignancies before and after X-ray treatment. The Granger exhibit, Charity Hospital of Louisiana, New Orleans, beautifully arranged and legended, did much to elucidate the points of the symposium on the nasal sinuses. Belden, of the New York Hospital, had a large series of prints and films covering the points of his paper on the diagnosis and therapy of intra-thoracic tumors and also illustrating bone tumors and massive atelectasis of the lungs. Quick, of New York, by charts, films, microphotographs, photographs and lantern slides contributed a most interesting and exhaustive study of intra-oral cancer, the subject of the symposium of which he was the director. Pritchard, of the Battle Creek Sanatorium, illustrated his talk on the bronchial injection

of iodized oils by a series of prints in bas-relief effect. Meyerding, of the Mayo Clinic, with an exhibit of bone tumors embracing mounted gross specimens, illuminated transparencies from X-ray films, microphotographs and reports arranged in series, presented this subject in a most interesting and instructive manner. Accompanying this exhibit was one of one hundred reductions from X-ray films with brief but comprehensive legends. Stein and Arens, of Chicago, showed twenty films covering their paper on lipiodol and pneumoperitoneum in relation to gynecology. Dunham, of Cincinnati, with a series of a hundred films, illustrated his paper on the value of the X-ray in the care of patients suffering from pulmonary tuberculosis. Lawrence, of Memphis, with a series of six films demonstrated the superiority of the 38-inch distance advocated in his paper on a new method of using the Bucky-Potter diaphragm. Hirsch, of New York, by an exhibit of lantern slides and transparencies exemplified the various points of his essay on the roentgen diagnosis of primary tumor of the lung and its differential diagnosis. Mills and Watkins, of Phoenix, greatly enhanced the value of their paper on the localizing of foreign bodies in and around the globe by an exhibit of thirty-five charts showing the practical application of the Sweet method; they also presented films showing studies in bronchiectasis by means of lipiodol. Lewis Gregory Cole, of New York, showed twenty-three films covering the points in the paper by Morse and Cole on the anatomy of the small intestine as observed roentgenologically.

Sixteen of the exhibits were explanatory of the papers given in the program and from the small groups frequently seen before each and all of them one can appreciate that many had made use of this innovation to clear up points not evident to them at the presentation or to accentuate detail not touched on by the author.

Space permits but a brief mention of the other contributions, their nature and points of particular interest.

The library exhibit of the Radiological Society of North America was augmented for the occasion by additions from the files of the Mayo Clinic and comprised over four hundred reductions, suitably mounted and all with brief but comprehensive legends describing the condition depicted. Chest and bone conditions, with a few interesting stomach lesions, were covered in this series. There were also groups showing tumors in the soft tissues and Charcot's disease of various joints.

Jerman, of the Educational Department of the Victor X-ray Corporation, presented a very beautiful exhibit of research work done at the Field Museum of Natural History. Squier, of the A. O. Smith Corporation, Milwaukee, Department of Preventive Medicine, sent an interesting set of charts and films demonstrating the scope of routine health examinations of employees.

The Madison, Wisconsin, exhibit included film displays from the departments of Urology, Surgery, Orthopedics, Gastro-enterology and Anatomy of the State of Wisconsin General Hospital; a display of reduced films on lesions of the gastro-intestinal tract, urinary tract and lungs from the Jackson Clinic and Methodist Hospital, and a display of reduced films from St. Mary's Hospital.

The Selmene Winter Foundation for the Developmental Study of Children had a very well arranged display of films of the thymus gland.

The Cleveland Clinic exhibit of sixty films included radiographic observations of the aorta and injected pathological kidney specimens.

The exhibit of Stevens, Jarre and Stone, of Detroit, comprised one hundred twenty radiographic reductions of lung abscesses under conservative management and during and after cautery lobectomy, lipiodol explorations, diaphragmatic hernias and a few rare diagnostic observations.

Scientific Exhibit, Twelfth Annual Meeting, Radiological Society of North America, at Milwaukee, Wisconsin, Nov. 29–Dec. 4, 1926

New York University and Bellevue Hospital Medical College, LeWald, showed radiographs and lantern slides of transposition of the viscera, non-rotation of the colon, Paget's disease, syphilis of the stomach, hair ball in the stomach, lung abscess and studies in the exact location of the heart valves, and anatomical variations in the skull and diploic veins.

The University of Michigan, Hickey, presented twelve films of pharyngeal diverticula, esophageal diverticula and esophageal carcinoma.

The Marshfield Clinic, Potter, had a miscellaneous display of fifty-one films covering unusual bone conditions, anomalies, fractures and bone diseases.

The Howard A. Kelly Hospital, Baltimore, Fricke, exhibited some films showing effects of radiation in malignancy, anatomical abnormalities and also some photographs illustrating water-cooled therapy equipment with underground installation. There were also a few examples of color photography.

The Milwaukee Health Department, Division of Tuberculosis, Ernst, contributed fifty-two films depicting enlarged tracheobronchial lymph nodes and pulmonary tuberculosis in childhood.

The Dubuque Medical and Surgical Clinic, Johnston, with thirty films and fifty prints illustrated the use of lipiodol in the diagnosis of chest and spinal cord lesions.

Trostler, of Chicago, by typed specimens made a plea for scientifically correct reports as a means of raising the radiologist in the esteem of the practitioner.

Johannessen, of Walla Walla, Washington, with radiographs visualized the entire digestive tract at one time. Alexander, of Evanston, Illinois, showed a miscellaneous set of films which included marble bone, thymus and pregnancy studies. Evans, of La Crosse, Wisconsin, showed a miscellaneous exhibit of films and lantern slides illustrating the usefulness of the X-rays in diagnostic work. Brown, of Ogden, Utah, exhibited a series of films depicting adult types of Perthes' disease. Schneider, of Milwaukee, showed eleven films of pathologic conditions of the hip. L. D. Smith, of Milwaukee, had ten films and forty-five lantern slides of orthopedic conditions. E. A. Smith, of Milwaukee, showed eleven mediastinal studies. Dakeman, of Muncie, Indiana, displayed films of a rare and interesting lesion in the upper end of the left humerus. Christenson, of Racine, Wisconsin, showed film studies of chest and bone conditions. Martin, of Michigan City, Indiana, had a set of miscellaneous films. Perry, of Kenosha, Wisconsin, showed chronic gout, spine lesions and three gastrointestinal films. Albert Bachem, Chicago, illustrating measured and applied X-ray dosage, showed the following: (1) Universal ionometer, standardized in *R*-units, for measurement of (*a*) the output of an X-ray outfit, in *R*-units; (*b*) the determination of the treatment time for producing various biological reactions; (*c*) the measurement of the effective wave lengths; (*d*) the distribution of applied energy on the surface and in body cavities; (*e*) the depth dose as measured in water phantom; (*f*) the comparison of radium therapy preparations. (2) Photometer, for determining the constancy of X-ray outfits. (3) Erythemameter, to determine the skin reaction quantitatively for scientific investigations. (4) Collection of pictures and preparations of organs which have been exposed to measured X-ray doses: kidneys, suprarenals, pancreas. The Harris Clinic, Fort Worth, Texas, R. P. O'Bannon, in a demonstration of gallstones with and without the intravenous injection of tetraiodophenolphthalein showed thirty-two films; with each a photograph of the gall bladder and stones after operative removal. E. H. Skinner, of Kansas City, Missouri, showed fifty films illustrating gall-bladder functions, frontal sinus fractures, and joint fractures. Lester Levyn, of Buffalo, New York, exhibited thirty mis-

cellaneous films. The Milwaukee County Dispensary, H. C. Dallwig, had an exhibit of thirty radiographs of the head and extremities. Marquette University, E. L. Miloslavich, Department of Pathology, showed an exhibit on osteopathology. These, together with the exhibit of the Milwaukee County Radiological Society, all combined to round out an exhibition both inviting and instructive.

Ideally situated to the left of the main entrance and registration desk, directly opposite a similar hall containing the commercial exhibit and given a certain dignity by the bronzed plate standing in the main doorway announcing it to be the Sandborn-Carman-Geyer Memorial Scientific Exhibit, it was at once a tribute to the purpose it represented and to its creators.

The Milwaukee local committee are to be congratulated; if future local committees will strive towards the same high standard the success of the Society as an educational institution is assured.

CHARLES G. SUTHERLAND, M.B. (Tor.)

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## AWARDS FOR SCIENTIFIC EXHIBIT

In the Scientific Exhibit, held in connection with the Annual Meeting of the Radiological Society of North America, at Milwaukee, November 29 to December 4, inclusive, the awards were as follows: First, Douglas Quick, M.D., New York; second, Bernard H. Nichols, M.D., Cleveland; third, H. Kennon Dunham, M.D., Cincinnati. The exhibits of Webster W. Belden, M.D., New York, Lewis Gregory Cole, M.D., New York, H. P. Doub, M.D., Detroit, Amédée Granger, M.D., New Orleans, E. C. Jerman, Chicago, Henry W. Meyerding, M.D., Rochester, Minnesota, Charles G. Sutherland, M.B. (Tor.), Rochester, Minnesota, W. W. Wasson, M.D., Denver, and F. B. Young, M.D., and A. L. Cooper, M.D., Scottsbluff, Nebraska, were among those which received favorable comment.

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## AWARD OF GOLD MEDALS

The Society awarded three gold medals for achievements in the field of radiology during the past year, the honors being bestowed upon Amédée Granger, M.D., of New Orleans, W. W. Wasson, M.D., of Denver, and William G. Hettich, of Chicago.

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## THE COMMERCIAL EXHIBIT

During the week devoted to the Annual Meeting, at Milwaukee, the Commercial Exhibit, on the main floor of the Auditorium, comprised the displays of the following firms:

The exhibit of the Acme-International X-Ray Co., of Chicago, was the source of much interest for the many mechanical and electrical improvements that have been contributed to the X-ray industry.

The Six-sixty X-ray Generator, for diagnostic work, was displayed in white enamel finish.

The 210 K.V. Deep Therapy Generator with its coronaless rectifying switch, proved that X-ray apparatus may be attractive as well as durable in construction.

A combination radiographic and fluoroscopic table was demonstrated, with a Bucky diaphragm capable of being used in any position desired.

Portable and cabinet high frequency generators were shown, with flexible controls, that easily and accurately produce all types of currents used in electrocoagulation and diathermy.

A magnetic sphere gap, flat Bucky diaphragm, cassette tunnels, and other accessory equipment were included in the exhibit.

Geo. W. Brady & Company exhibited their well known line of curved and flat top

Buckies, including the electric contact attachment for throwing the machine time switch on and off at the proper points, also a new type head clamp to be attached to either the Bucky diaphragms or to the bakelite top plate changing tunnels. They also showed a new integrating automatic time switch for X-ray or physiotherapy treatments, which starts the clock when the switch is thrown on and will stop the treatment at the predetermined time. If the current is shut off for any reason the clock stops until the switch is thrown on again, thereby insuring accurate treatment dosage.

They also showed a new Arcelin position attachment for the Granger Mastoid Localizer whereby mastoids may be radiographed accurately with the patient lying on his back, a new type of X-ray protective apron, a new interval treatment timer clock, an all-steel enameled illuminator for $14 \times 17$ film, Iodeikon in three forms for gall-bladder work, and a simple device for measuring heart outlines.

The Bruce Publishing Company, of St. Paul and Minneapolis, from whose press RADIOLOGY, the Society's journal, issues, exhibited two books of interest to radiologists, Dorland and Hubeny's "The X-ray in Embryology and Obstetrics," and the third printing of "Diathermy in the Treatment of Genito-urinary Disease, with Especial Reference to Carcinoma," by Corbus and O'Conor.

The Buck X-ograph Company, of St. Louis, showed X-ray films in large sizes, and also those for dental work, for all of which extreme contrast and brilliancy, with freedom from chemical fog, were claimed. The exhibit was presided over by Mr. Buck himself, assisted by Mr. Otto Krog and Mr. Stephen J. Cowles.

The value of "high visibility in diagnosis and surgery," as applied to all phases of major and minor diagnostic, operative and therapeutic procedure, was demonstrated at the clinical exhibition of Cameron's Surgical Specialty Company, of Chicago. Those interested in a demonstration of transillumination "on the searchlight principle," in securing accurate diagnoses of sinus involvements and alveolar infections, and the use of the Surgilites in gall bladder, stomach, appendectomy, urological, proctological and other procedure evinced interest in this Company's exhibit.

The Dennos Products Company, of Chicago, exhibited Dennos Barium Meal, a barium sulphate blended with prepared cereals, the whole product having the appearance and consistency of fine flour. It is prepared by mixing with water, the resulting opaque meal being a smooth, free flowing mixture having about the consistency of rich cream and the taste of well-flavored bread.

The exhibit of the Eastman Kodak Company, of Rochester, New York, comprised a showing of the possibilities of photography in medical science. Radiography in its most recent applications was demonstrated, also clinical photography—by both still and motion pictures.

The Engeln Electric Company, of Cleveland, had on exhibition the apparatus manufactured by this Company, demonstrated and explained by Mr. Engeln himself, whose many friends greeted him with enthusiasm.

The French Screen Company, of Detroit, was represented as usual, with a showing of their Intensifying Screens and Fluoroscopic Screens.

At the exhibit of the Hanovia Chemical and Manufacturing Company, of Newark, New Jersey, visitors renewed acquaintance with old friends and felt the stimulation of contact with the enthusiasm of the representatives of this organization. The Alpine Sun and Kromayer lamps were introduced

many years ago, and for a period offered the only evidence that light therapy was destined to be anything but a transient dream. These modalities, in new form, together with the Luxor and Sollux models, are now manufactured in four countries. All these were on exhibition, with a staff of experts including Messrs. W. R. Hosmer and W. C. MacKellar, in attendance to explain them.

The High Tension Company, of Union City, New Jersey, displayed its regular line of high frequency apparatus together with its very latest development in high frequency equipment, namely, the Hy-Volt High Frequency Machine, which develops a d'Arsonval voltage of approximately 60,000 volts. The theory underlying the use of high voltages for diathermy is that this high voltage will cause a more effective diathermization of the area under treatment by thoroughly saturating the tissues between the electrodes with current throughout the entire area. One of the special values of high voltage, outside of those just mentioned, is that there is an absence of extreme surface heat on the skin directly under the electrodes. With lower voltages, the skin heat rises so rapidly that the tolerance of the patient to this heat is reached before the required internal heat is generated.

The transformer used in this apparatus is especially constructed and oil-immersed in a galvanized steel tank. The oscillation circuits also represent a new departure in the construction of high frequency apparatus, and are the result of several years' intensive laboratory research work.

Horlick's Malted Milk Corporation, of Racine, Wisconsin, was another exhibitor. In addition to demonstrating the use of Horlick's Malted Milk as a medium for the suspension of barium salts, the Horlick representatives displayed Malte-Chocla, a combination of Horlick's Malted Milk with sweet chocolate and cocoa. This product, while not new, has not been pushed aggressively by the Horlick Corporation heretofore. It is now being given general distribution in response to a demand for a chocolate-flavored beverage, and it is thought that it will become popular as a suspension medium in X-ray work.

Paul E. Johnson, Inc., of Chicago, exhibited the Spectro-Sun, an improved, automatic carbon arc ultra-violet lamp, which operates on either alternating or direct current. It is claimed for this lamp that it is absolutely silent in operation, without complicated transformers. It is supplied with localizing attachment and three applicators, for local and orificial radiation. It is portable; weight, complete, 35 pounds. Its makers say that the Spectro-Sun is not a dazzling new discovery, but the product of years of labor, research, and development.

The exhibit of the McIntosh Electric Corporation, of Chicago, was displayed by the E. H. Karrer Co., of Milwaukee, and included the new McIntosh Ultra-violet Lamp. This lamp, its exhibitors claim, has all possible adjustments and ball-bearing movements, and its mahogany mounting on a four-foot base harmonizes with the cabinet-stand of the new Polysine Generator. This Polysine, with its white porcelain top, has many new features, as demonstrated by Mr. Charles Hanson, the representative in charge, who pointed out that only the current modality selector and voltage control handles, with wave speed regulator, meter, switch, and two binding posts, are on top of the apparatus, all the other mechanism being underneath the base. It generates galvanic, sinusoidal, and all the practical wave currents.

The Hogan Superpower High Frequency Apparatus, with its d'Arsonval, Tesla, and Oudin currents, took prominence in the dis-

play, as did also the Portable Diathermy—really a portable with ample volume.

The small Infra-red Generator was also shown, with the B-B Biolite towering over it, both with wire screen protectors.

The X-ray apparatus featured by the Kelley-Koett Mfg. Company, of Covington, Ky., revealed new, improved designs with added conveniences. The Diagnostic Table, shown for the first time, is a convenient specialized diagnostic table for both fluoroscopy and radiography. A flat Potter-Bucky diaphragm which may traverse the full length of the table and the rail-mounted, counterbalanced screen or tube carrier are so arranged as to leave the entire front of the table free for the movement of the patient and for convenience of manipulation. The Radiographic Head Table, adapted from one originally designed by Drs. Paul and Fred Hodges, presents a new epoch in head radiography. Any angle or position of the tube relative to the film may be obtained with a minimum of effort and time. The Orthodiagraphascope makes possible the recording of outlines of organs as they are seen by the fluoroscope and offers a new design in this type of apparatus. The 10-inch Double Disc Apparatus is a highly perfected generator, that combines ease of operation with an unusual degree of power. The stereoscope shown was of the latest type, equipped with Norski Light Filters which serve to absorb the red and yellow rays, thereby disclosing a clear and more effective light for the interpretation of radiograms. These improvements mark an advance in generator and accessory apparatus construction and open a new field of X-ray possibilities.

The Liebel-Flarsheim Company, of Cincinnati, Ohio, had on exhibition a new Treatment Timer for timing X-ray, diathermy, quartz lamp and radiant lamp treatments. This new timer, which requires no winding, can be set for any period of time, from one minute to one hour; it automatically cuts off the current at expiration of the time. A special feature of this timer is that it is automatically integrating—the timer switch can be turned on or off as frequently as desired during treatment and the timer automatically sums up the different periods of actual treatment, thus eliminating guesswork and calculating. A set-back feature permits the pointer to be overset, then turned back to exact time desired. The setting of the treatment machine can be tested, but switch will not remain on unless timer is set. It operates on any X-ray machine equipped with magnetic switch. On mercury vapor or radiant heat lamps, it eliminates accidentally leaving lamp burning over night.

Other equipment displayed was the Dynelectron, the Dr. H. H. Young Genito-urinary Table, and the Electric Scalpel. This latter apparatus cuts the tissues in the manner of a sharp scalpel, the severed edges of tissue presenting a thin depth of dehydration which seals up the capillaries and prevents bleeding or oozing.

The National Intensifier Company, of Milwaukee, showed Nico Fluoroscopic Screens, Nico Lead Glass, and Nico X-ray Intensifying Screens. Mr. E. J. Warren represented the company.

The Patterson Screen Company, of Towanda, Pennsylvania, exhibited the Patterson Cleanable Intensifying Screen and Patterson Fluoroscopic Screens, products that have been standard for years and well known to the profession. Along with these items was demonstrated the Patterson Foreign Body Fluoroscope, conceived by Dr. Robert A. Arens and developed by the Patterson Screen Company. This instrument, a small fluoroscopic screen arranged so that it can be sterilized, has been suc-

cessfully used in the removal of opaque foreign bodies.

James Picker, Inc., of New York, were represented by an exhibit of the modalities with which the name of this house is associated in the minds of roentgenologists. The representatives of this house stress the engineering service rendered, placing such services to roentgenologists above sales. It maintains a staff of college-trained X-ray engineers, whose sole purpose is to give the physician expert service and counsel in X-ray and allied matters. After all, a roentgenologist needs a great deal more than the X-ray apparatus he may buy. Intelligent, expert co-operation in choosing apparatus best suited to his needs is primarily important. Correct installation, which does not upset his office routine, makes easier the work which the physician who specializes in the use of the X-ray must do. And, finally, assurance of an ever-ready source of supplies and instantly available service, given without stint, are factors which may play an important rôle in the progress of the roentgenologist.

The Radiograph-scope Company, of Greensboro, North Carolina, showed Dr. Reaves' Radiograph-scope, a device optically built for rendering adaptable to the observer's eyes stereoscopic pairs of radiographs by the combined advantages of first surface mirrors, binocular lenses, chromatic illumination, angulation, and co-ordination. Point by point, the features set forth as distinguishing the Radiograph-scope are: (1) First surface mirrors (clear stereoscopic box), which eliminate first surface reflex. (2) Double duplex curtains, holding roentgenogram in center of view box. (3) Angulation, which eliminates all distortion and elongation when roentgenograms are taken at angles to prevent the greater opacities from obscuring the lesser opacities. (4) Co-ordination, enabling one to study the roentgenogram's field in the most comfortable position for the eyes. (5) Binocular lenses, giving a flexibility of the vision of youth by adjustable focus for the roentgenogram exposure distance which does away with the need for reading glasses. (6) Chromatic illumination—different colors give greater contrast to binocular angulation, thereby increasing detail, dimension, and position.

The Standard X-ray Company, of Chicago, had on exhibit in their booth three sizes of the new De Luxe machine, equipped with the now famous "Limited Capacity," which insures safety from serious electrical shock to patient or operator. Another feature of these machines is rectification of the high tension current by ionized commutation.

This Company also showed a new instrument, the Roentgenometer, for continuous measurement of output from the X-ray tube. Its use makes possible accurate dosage under any and all conditions.

New cassettes of molded bakelite were on display, marking an advance in this important accessory.

Other equipment of interest was a new type stereoscope, and a new type horizontal fluoroscope, with Bucky diaphragm and tube column for quick change from fluoroscopic to radiographic work.

The Swan-Myers Company, of Indianapolis, exhibited a capsule called Iodeikon (tetraiodophthalein sodium salt), manufactured by the Mallinckrodt Chemical Works, to be used in cholecystography. Any oral administration of tetraiodophthalein sodium must provide for the passing of the dye through the stomach and the protection of it from the acid gastric juice. The dye must then be quickly liberated in the small intestine, and absorbed rapidly. A number

of substances have been tried, but it has become evident that keratin—an inert substance—is the ideal protective coating. It resists acid digestion, and is soluble in the alkaline juices of the stomach. These Swan-Myers Iodeikon Keratin Composition Coated Capsules were recognized by many men when they visited the exhibit, as being a well known medium for administering the dye.

The interest aroused by the Victor exhibit was manifested by the expressions of visitors. As one well-known roentgenologist remarked: "I never fail to allow myself sufficient time during the meeting to look over the Victor exhibit, for it helps me to keep posted on the important new developments in apparatus with which our work may be further simplified and results improved. We can always depend on their research and engineering departments to anticipate our requirements for the ever-advancing methods and technics in the X-ray art. We are all interested in knowing how some of our apparatus problems are being solved, and I for one always get a number of valuable suggestions from these periodical Victor exhibits."

The Victor exhibit occupied five sections in one of the center aisles. Even in a space of these generous proportions obviously no attempt was made to introduce the Victor line as a whole. The space was divided as follows:

*Section I.*—A collection of radiographs produced by the Victor Educational Department, showing the results with modern technics, and with the high milliamperage Coolidge Tube.

*Section II.*—A display of recent developments in X-ray apparatus, including (a) the Model 16 Table, with motor-drive for raising and lowering to any angular position from Trendelenburg to vertical; (b) the Vertical Stereo-radiographic Unit for stereos of the chest, or for gastro-intestinal, gall-bladder and cervical radiography in the vertical position, combining a new type stand, and with magnetic release for shifting the cassettes and tube simultaneously; (c) a new and improved Double-disc Rectifying Transformer for radiography and fluoroscopy; (d) an ingenious remote control stand with which the operator may change instantly the tube current from a fluoroscopic setting to a radiographic setting, permitting radiographs to be made selectively during the fluoroscopic examination; (e) the new Victor Portable X-ray Outfit incorporating a stabilizer which maintains a constant tube current regardless of line fluctuations.

The "CDX" Dental X-ray Unit also attracted attention, being the smallest outfit of its kind, shock-proof, and requiring only a small wall space for installation. Many roentgen laboratories are including this dental unit as part of their regular equipment, as it facilitates the making of complete radiographic records, including the teeth.

*Section III.*—Physical Therapy Apparatus, including (a) the Vario-frequency Diathermy outfit, with which the operator may select that frequency which has proven most effective for the treatment of a given condition; (b) the Wantz Multiple Wave Generator, furnishing all the approved forms of sinusoidal and galvanic currents for therapeutic purposes; (c) the Model "B" Air-cooled Quartz Lamp and the new Water-cooled Quartz Lamp with counterweight for suspending and automatically retaining the applicator in treatment position.

Of particular interest was the Victor Portable Electrocardiograph. This instrument utilizes amplification methods similar to those used in radio receivers, *i.e.*, through the use of three special amplifying tubes,

The result is an outfit of portable size, and rugged construction, capable of doing the most critical work demanded in electrocardiography.

*Section IV.*—A representative line of X-ray accessories and dark-room equipment as approved by the Victor Supply Sales Division.

*Section V.*—A resting place for the tired wayfarer, furnished for the comfort of visitors.

Each section was in the hands of a competent demonstrator. Many of the leading lights in the Victor organization were on hand to discuss the problems of the visiting roentgenologists.

The Wappler Electric Company, Inc., of Long Island City, N. Y., had on display the Monex and Diex Valve Tube X-ray Machines, the J. Bentley Squer Cystoscopic Radiographic Table and a new indirect illumination stereoscope with separate dimmer controls for each box and with individually adjustable mirrors.

The centers of interest of the display, of course, were the X-ray machines, in which the current is rectified with valve or "Kenex" Tubes, thereby eliminating all noise and moving parts that are a necessary adjunct of the mechanical rectifier apparatus.

The nucleus of this new apparatus is the "Kenex," a two electrode hot cathode vacuum principle, resulting in new characteristics, which are mated with specially designed transformers, and, in certain cases, with high voltage condensers, making possible rectification and delivery to the X-ray tube of either larger volumes of current or higher voltages than heretofore, generated in a similar way.

The new properties gained thereby are absolutely silent operation of the apparatus, and greater efficiency of the current applied to the tube, thus shortening the exposure time. In the design of the apparatus the various circuits are so balanced, the one relative to the other, that the operating of the tube is stable, and, therefore, results are reproducible with absolute certainty.

These new types of X-ray apparatus open up a new era of X-ray technic. To sum up, operation is simplified, comparatively small amount of space is needed, no spark gaps nor polarity meters or commutators are required, noise, gases, corona are eliminated, and—a very important consideration at the present time—no interference in the operation of radio apparatus takes place.

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## EPIPHYSEAL UNION AND AGE[1]

Although the time of union of the various epiphyses, and the sequence of their union, have long been known to bear a relationship to age, authorities have differed anywhere from three to eleven years in the dates that they have assigned for union in various parts of the skeleton. A recent investigation,[2] based on an intensive study of 109 age-known normal skeletons, affirms that "the sequence of union among the various epiphyses is observed to be exactly the same in every individual," and that within the limitations of the period of activity, which lies between the ages of 15 and 20, epiphyseal union is the most reliable of the various age indicators in the skeleton. With respect to age determination, the bones fall into two groups. In the group of long bones, the time of epiphyseal union is remarkably constant; in the other group, made up of the innominate, scapula, ribs and clavicle, the date of union is subject to some individual variation. A single bone may tell much concerning the age of an individual. For instance, in the humerus, the

[1]Reprinted by permission from Jour. Am. Med. Assn., Oct. 30, 1926, p. 1483.

[2]Stevenson, P. H.: Age Order of Epiphyseal Union in Man. Am. Jour. Phys. Anthrop., Jan.-March, 1924, VII, 53.

distal extremity unites early in the period of activity; the proximal extremity, late in the period. Accurate determination of age, however, depends on correlation of the stages of the union found in various bones rather than on the condition in any single portion of the skeleton. By the employment of the "epiphyseal key" that has been developed, the age at death of any person whose skeleton is preserved can be worked out. If confirmed, the importance of this work will be great to anatomists, archeologists and medicolegal experts.

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## REPORT OF COMMITTEE TO INVESTIGATE HOT CATHODE TUBE SITUATION

The committee appointed at the Cleveland meeting, December, 1925, to investigate certain complaints regarding hot cathode X-ray tubes, reported at the Milwaukee meeting, November 30, 1926. The report was received and the committee continued for another year. Instead of sending out further questionnaires, the committee is using this means to get in touch with all physicians and hospitals using hot cathode X-ray tubes and will appreciate receiving written reports of any cases where the tubes have seemed to be defective or the adjustments allowed unsatisfactory. The committee wants only reports on cases which come up during this coming year and all facts must be stated in writing in order that each case can be properly investigated. All physicians and hospitals using hot cathode X-ray tubes will aid this committee in their work if they will send communications direct to any member of the committee.

(Signed) G. D. Bliss, M.D., *Chairman*,
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# BOOK REVIEWS

A Practice of Physiotherapy. By C. M. Sampson, M.D., formerly of the Physiotherapy Service, Walter Reed U. S. Army General Hospital, Washington, D. C.; formerly Chief of Physiotherapy Service, U. S. Army General Hospital No. 9, Lakewood, N. J.; formerly Chief of Physiotherapy Service, U. S. Army General Hospital No. 41, Fox Hills, Staten Island, New York, later Hoff General Hospital; formerly Reconstruction Officer U. S. Public Health Service Hospital No. 61, Fox Hills, Staten Island, New York, later U. S. Veterans Bureau Hospital No. 61; formerly in Charge Reconstruction U. S. Public Health Service Hospital No. 70, New York. Cloth. Pages 608, with 146 illustrations. St. Louis: C. V. Mosby Company, 1926.

This is an excellent 608-page treatise on the various aspects of physiotherapy as developed in the practice of the author. The printing is well done. The illustrations are fairly numerous. Many of the subjects are handled very satisfactorily. There is some lack of balance, however, in the book, as illustrated by the fact that hydrotherapy, one of the most useful means of employing heat in a therapeutic way, is given only fifteen pages, less than that devoted to the treatment of X-ray burns. Massage is also given much less space than it deserves. The result of this lack of balance is undue prominence to some of the branches of electrotherapy, in the practice of which it is so easy for a physician to get into a rut or to go off at a tangent from the main line of reasonable therapeutic endeavor. This book is one of a group which should become fairly numerous in the near future and should find a place among the handbooks of ready and frequent reference for every practitioner.

James T. Case, M.D.

PANCREATITES CHRONIQUES AVEC ICTERE. By PIERRE MALLET-GUY. Pages 307, 8 illustrations. Paris: Masson & Cie., 1925.

To the internist this review of an extremely serious diagnostic problem is of real interest. Jaundice, due to chronic pancreatitis, presents almost insuperable diagnostic difficulties, and at best, individual experience in this rare syndrome is limited. Mallet-Guy has culled the literature and, including personal observations, presents and discusses nearly 150 cases with operative or necropsy notes. These cases are confined to those presenting "an obstruction of the common bile duct, the cause of which can be found only in a chronic inflammation of the head of the pancreas."

As illustrated by his case reports, most of which are given in satisfactory detail, the differential diagnosis lies between common duct stone, cancer of the head of the pancreas, and chronic pancreatitis. Laparotomy alone can determine the actual pathology, either by direct examination or by the results of operative treatment. A careful perusal of the cases described, however, impresses one with the importance of exploration in cases of unexplained obstructive jaundice, with or without pain, even where malignancy seems probable. The frequent occurrence of colicky pain, associated rarely with ascites, is of interest.

Cholecystostomy or cholecystgastrostomy is advised as treatment, and a cure is admitted only after an absence of symptoms for at least eighteen months. X-ray illustrations demonstrating the patency of the cholecystgastrostomy are of interest. The author presents nothing new as regards etiology, but as a résumé of the symptomatology and therapeusis of this rare condition, the book is of real clinical value.

CHESTER M. JONES, M.D.

# ABSTRACTS OF CURRENT LITERATURE

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**Roentgen rays and yeast.**—The author presents, in this paper, the results of a series of very careful investigations as to the separate and combined effect of roentgen rays and certain chemicals on yeast. His findings are somewhat at variance with the observations published by Groedel and his pupils. It appears that roentgen rays do cause a latent change of the condition of the cells, manifesting itself in an increased sensitivity. The ferment in the yeast is rather independent of the cell and its condition and does not respond in any way to irradiation.

E. A. POHLE, M.D.

*Effect of Medicaments and Roentgen Rays on Yeast. H. Zeller. Strahlentherapie, 1926, XXIII, 336.*

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**Decomposition of starch and roentgen rays.** — Haehn-Biedermann published a method which led to the decomposition of starch without the presence of a ferment. The author repeated this procedure but could not reproduce the same result. He investigated, then, the influence of roentgen rays on the process. No change in the starch molecules seems to take place, even after exposure to 20 S.U.D.

E. A. POHLE, M.D.

*Experimental Investigations Regarding the Effect of Roentgen Rays on the Decomposition of Starch. E. Schneider. Strahlentherapie, 1926, XXIII, 326.*

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**Ureteral irradiation.**—Particularly in infiltrating malignancies of the cervix uteri, the ureters must be watched for encroachment of the infiltration, and therapeutic measures instituted. Experiments previously described show that 2½ erythema doses of the gamma rays of radium did not damage the ureters enough to interfere with their function. Hence, well-filtered radium within the uterus or vagina does not endanger the ureters.

Detailed reports are given of experimental work on dogs, implanting radium needles parallel to the ureters. Autopsies performed and filling of the ureters and kidney pelves with an opaque substance, showed little involvement of ureters in the reaction when very small doses for very short periods were instituted, although the end-results may not have been reached at the time of autopsy. When the radium was applied for longer periods, obstruction of the ureter was almost complete, with resulting hydronephrosis.

The experiments show that 75 mg.-hr., ordinarily a moderate dose for the implanted needle, is beyond the safe limit for the dogs' ureters. The authors conclude that to blindly insert needles into the broad ligament areas is dangerous when the 75 mg.-hr. dose is given, and the end-results for smaller doses may well be quite dangerous.

TRESSA R. MORAN, M.D.

*Effect of Irradiation on the Ureter. C. L. Martin and Fred T. Rogers. Am. Jour. Roentgenol. and Rad. Ther., September, 1926, p. 215.*

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**Action of radiotherapy.**—The two supposed actions of roentgen and radium rays mentioned in the title of the paper are considered by the author to be complete fallacies. The immense mass of experimental work tending to prove that these radiations have no stimulating effect whatever on simple forms of life, but rather a destructive effect from the beginning and in proportion to their intensity and period of application, is briefly reviewed. The few and, to the author, inconclusive experiments tending to show a stimulating effect are likewise mentioned and the weaknesses inherent in the reasoning which deduces stimulation from such experiments are pointed out. The conclusion is reached that any apparent stimulation is only a transient phase, invariably followed by more or less pronounced functional or organic deterioration.

The theory that the effect of radiation in destroying tumors is in whole or in part due to the production of some sort of immunity by the action of the rays is likewise criticized. A number of arguments tending to make such theories untenable are advanced. It is concluded that all the effects of radiation on tumors can be explained on the basis of the

direct action of the rays on the tumor cells, the connective tissue stroma and the blood vessels supplying nourishment to the pathological tissues.

C. D. ENFIELD, M.D.

*Stimulation and Immunity in Radiotherapy. Arthur U. Desjardins. Jour. Am. Med. Assn., Nov. 6, 1926, p. 1537.*

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**Treatment of bladder tumors.**—The authors conclude that fulguration and the direct application of radium through the urethra give best results in benign papillomata of small or medium size. In extensive lesions, they add external irradiation by means of deep therapy. Small malignant papillomata and infiltrating carcinomata are effectively treated by transurethral, intravesical and local applications, in addition to which external radiation is given. Large malignant papillomata and infiltrating carcinomata limited to the bladder are treated differently in the male and female. In both, if the tumor is not too extensive, or is limited to a movable portion of the bladder, the removal of the tumor and wide resection of the bladder wall is done through a suprapubic incision. When resection is difficult, in the male, treatment is by implantation through the suprapubic incision; but in the female, the implantation is more easily carried out through the urethra. In extravesical lesions, the treatment is limited to moderate intravesical applications and heavy external irradiation, crossfiring to cover the entire lesion through a number of portals.

TRESSA R. MORAN, M.D.

*Treatment of Epithelial Tumors of the Bladder. Curtis F. Burnam and William Neill. Am. Jour. Roentgenol. and Rad. Ther., September, 1926, p. 219.*

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**The radiotherapeutic menopause.**—Premature menopause is a frequent necessity in modern medicine. This study was undertaken to determine the effect of the radiotherapeutic menopause on women of various ages. The conditions investigated were: earning capacity, change in weight, in age appearance and sex appearance, libido, change in blood pressure, in the joints, in the nervous condition of the patient, hot flashes, and other unaccustomed sensations. In practically every instance the earning capacity has been increased. The age appearance, as judged from the graying of the hair, wrinkles, etc., was not perceptible. Sex appearance, as judged from changes in hair distribution, voice, attitude toward the opposite sex, libido, and the breasts, was not definitely affected. Basal metabolic rate seems to have remained unchanged. Hot flashes occurred with such frequency as to be regarded as a constant result. A study of the blood pressure showed a slight tendency to its elevation, but this could be attributed always to some associated renal or other disease. Certain nervous disorders occurred at times, most serious of which was involutional (menopause) psychosis; these always occurred in patients giving a history of previous family psychopathic involvement.

The author's conclusions are as follows:

"1. The only constant symptom of the radiotherapeutic menopause is the so-called 'hot flash.'

"2. Associated with the hot flash there occasionally occur sensory disturbances, predominant among which are numbness and tingling in the fingers and a sense of stiffness in the hands.

"3. A few women over the age of forty appear to have increased blood pressure after the radiotherapeutic menopause, in each case explainable by kidney disease, mode of life, or emotional state. There were no cases in women under this age.

"4. Changes in the age appearance, secondary sexual characteristics, and libido have not occurred.

"5. Obesity has not occurred with any regularity. The basal metabolic rate has shown no change.

"6. Psychic disturbances are rare. The cause seems to be similar to that of other psychoses and not directly attributable to the loss of ovarian secretion.

"7. The management of symptoms and conditions following the radiotherapeutic

menopause should be based upon general principles rather than upon the theory that they are caused by the loss of the ovarian secretion."

L. R. SANTE, M.D.

*The Radiotherapeutic Menopause: Its Significance and Management. James A. Corscaden. Am. Jour. Obst. and Gynec., June, 1926, p. 803.*

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**Iodized oils.**—This is a study of the comparative merits of the various oils on the market as regards toxicity, irritating qualities, stability, and absorbability, supplemented by a résumé of the rapidly growing literature on the subject of radiopaque oils. The author says that "though a considerable number of accidents has been reported, these oils find a growing use."

Iodized oils have been known for many years as palatable forms of iodine. To Sicard and Forestier (see RADIOLOGY, April, 1926, p. 303, and November, 1926, p. 385) is given the credit "for having utilized their opacity for outlining cavities of various kinds, and finally, of attempting to localize spinal cord tumors by their aid."

The paper is a preliminary report of work carried out at the Harvard Medical School Laboratory for Surgical Research, looking toward an investigation into the comparative merits of various types of halogenated oils, not only to test those already in use but to make other halogenated oils of different chemical compositions and physical properties for purposes of comparison. After an attempt to prepare from each of various oils the most concentrated iodine compound that would remain stable, the corresponding bromine compounds were made by adding the bromine directly to the oil, vigorously stirred.

In testing the irritating and absorptive qualities of oils it became evident that the vegetable oils are more irritating than the animal oils, while the latter are more rapidly taken up than the former. The difference in behavior is undoubtedly explained in part by the fact that animal oils are readily emulsified, which process is the first step toward absorption. Among other conclusions arrived at by the author is one to the effect that "by forming bromine substitution products, rather than iodine addition compounds, various animal oils may be made sufficiently opaque for many radiographic purposes."

*Some Brominized Oils for Radiographic Use: Preliminary Report. Tracy J. Putnam. Jour. Am. Med. Assn., October 2, 1926, p. 1102.*

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**Skin tolerance.**—The point is made that telangiectasia probably never develops except as a sequel to an erythema, although the antecedent erythema may have been very slight or quite evanescent. When telangiectasia develops, it is usually within two years, though it may be delayed until five years or even longer, after radiation. The changes sometimes associated, as atrophy, changes in pigmentation, scleroderma, keratoses, ulceration and epithelioma, more commonly occur subsequent to severe reactions or repeated mild reactions during a long course of treatment, although rarely they may occur following a single mild reaction. The atrophic changes may become more conspicuous as the patient grows older or thinner.

Consideration of these late effects led to an effort to determine the probable range of skin susceptibility. Two hundred and ten patients were tested for skin tolerance by giving ¼, ½ and ¾ of a skin unit of unfiltered radiation to areas about the size of a postage stamp on either the flexor surface of the forearm or the inner surface of the thigh. Five per cent developed erythema with ¼ unit, 15 per cent with ½ unit, and 54 per cent with ¾ unit. Eight per cent of blondes showed erythema with ¼ unit as compared with only 4 per cent of brunettes. Forty-six per cent of all patients showed pigmentation with ¼ unit, 50 per cent with ½, and 51 per cent with ¾. Pigmentation occurred in a greater percentage of brunettes than blondes. This change alone is not considered of importance and is not believed to be followed by unpleasant sequelæ.

It was found, contrary to the usual impression, that a given dose was as effective over a small area as over a large one unless, indeed, the small area was extremely minute. Areas described as "split pea size" required a larger dose to produce a given change than areas of postage stamp size.

The authors arrive at the following, among other conclusions: "There is, as is well known, considerable variation of susceptibility to roentgen rays. For the most part, this variation is caused by age, location, complexion and the inaccuracies of the best technic. In addition, there is some evidence to support the belief that mild grades of idiosyncrasy occur."

The authors are making it a routine to test the skin tolerance of patients before beginning a course of treatment.

C. D. ENFIELD, M.D.

*Variations of Cutaneous Toleration for Roentgen Rays. George M. MacKee and Joseph J. Eller. Jour. Am. Med. Assn., November 6, 1926, p. 1533.*

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**X-ray treatment of exophthalmic goiter.**—The author gives an account of 50 cases of exophthalmic goiter treated with X-rays and kept under observation for several years, clinical examinations and estimations of the basal metabolic rate being made at frequent intervals. The average number of X-ray treatments required was ten, with a maximum of twenty-seven and a minimum of three. Improvement in symptoms was usually rapid, the patients feeling distinctly better and less toxic. A tendency to gain in weight, often before there had been any fall in the basal metabolism, and disappearance of nervousness and sleeplessness, were among the early signs of improvement; in early cases palpitation and tachycardia quickly disappeared, though they were more persistent in cases of longer standing.

Of his 50 patients, 41 became and remained cured, and of the remainder 3 were improved, 4 were operated upon, and 2 were lost sight of. The treatment rarely caused any discomfort, and the majority of cases were treated as ambulatory patients, with advice to rest as much as possible and to take a high caloric diet, only those with severe myocardial symptoms being ordered complete rest.

Sanger concludes that the treatment is safe and satisfactory, and offers a high percentage of cures.

*Exophthalmic Goiter. B. J. Sanger. Archiv. Int. Med., May, 1926, p. 627. (Reprinted by permission from Brit. Med. Jour., Oct. 2, 1926, p. 47 of Epitome of Current Medical Literature.)*

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**Oral method of cholecystography.**—This is a report on one hundred consecutive cases of the oral administration of tetraiodophenolphthalein. Two patients were under 20, the rest from 20 to 60 years of age, the greatest number being from 30 to 40 years. The weight was also considered, since it is usually accepted that gall-bladder disease is associated with obesity. The greatest number of patients weighed between 110 and 150 pounds. Ninety-one of the hundred cases showed a gall-bladder shadow, and of the nine "no-shadow" cases, seven were operated on. Pathological gall bladders were found in all seven cases; most of them contained stones, with obstruction of the cystic duct. Sixteen cases showed persistency of the shadow for at least thirty-six hours, but only one was operated on. In this case the gall bladder contained no stones, there were no adhesions and it was easily emptied but was bluish in color. It was not removed.

Without the dye, stones were recognized in eight of the cases, but after the administration of the dye, twenty-six additional cases of stones were diagnosed. Fifteen of the thirty-four were operated on and in all save one case, stones were found. The total number reported to be pathological was sixty, of which twenty-three were operated on, and in twenty-one the diagnosis was confirmed.

While it is usually considered that the oral administration causes more reaction, the writers affirm that in their experience this is not true, since only eleven patients had a slight nausea, vomiting occurred in seven cases, and a slight diarrhea in eight. No patient was incapacitated.

The oral method has the advantage of sim-

plicity, lack of severe reaction, no danger to the patient, and can be used in office practice. The authors believe that a preliminary fatty meal is essential in emptying the gall bladder. A fresh drug is necessary, since the dye readily deteriorates. During the taking of the films, the patient must hold the breath, especially when the Bucky diaphragm is used. The fasting condition for sixteen hours after taking the dye is also necessary, to allow slow filling and complete concentration. If these details are carefully carried out, the method is reliable and it is not necessary to check unsatisfactory results with the intravenous method. Another oral administration, watching all details carefully, is all that is necessary.

TRESSA R. MORAN, M.D.

*The Reliability of Cholecystography by the Oral Method. William H. Stewart and Eric J. Ryan. Am. Jour. Roentgenol. and Rad. Ther., September, 1926, p. 234.*

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**Angiosarcoma following roentgen radiation.**—The histological differentiation between the neovascularization due to neoplastic origin and granulation tissue is not always easy. A case report, with discussion, shows a microscopic picture of malignancy, with insignificant clinical picture. There was a history of repeated roentgen-ray treatment for hypertrichosis of the chin, with subsequent keloid formation and ulceration of the central portion, the surrounding skin being atrophic, with telangiectasis. Histological examination of the excised portion showed chronic inflammation, with ulceration. Almost three years later, a purple nodule at the site of the operation was excised and diagnosed as an angioblastic sarcoma. Microscopic examination of nodules removed on three subsequent occasions, once after radium treatment and once after the injection of Coley's fluid, gave the same findings. The wound never healed and deep ulceration occurred, with extensive invasion of the underlying structures. Death resulted.

Careful histological examination of the nodules and surrounding skin in each case showed atrophy of the hair follicles and glands, extensive proliferation of dilated capillaries, and, in the subcutaneous tissue, abundant large spindle and small round cells. No definite relation between the irradiation and sarcoma formation has been traced, as in the carcinoma from roentgen-ray injury, and reference is made to the few cases previously reported wherein the relation was suspected. The authors in this case were able to trace the atypical blood vessel proliferation back to the endothelial lining of the cutaneous telangiectasis of the roentgen-ray injury.

TRESSA R. MORAN, M.D.

*Malignant Angiomas, with Reference to the Question of Sarcoma Due to Roentgen Ray. S. F. Livingston and Paul Klemperer. Arch. Pathol., June, 1926, p. 899.*

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**Biology of roentgen rays.**—This paper presents a summary of the investigations of Groedel and his co-workers to support the hypothesis: The principal point of attack of X-rays in the organism can not be in the cell itself. The last chapter relates the results of experiments on guinea pigs which were fed with irradiated carrots. This food seemed to be poisonous for the animals; as explanation, the possibility of an avitaminosis is suggested.

E. A. POHLE, M.D.

*Biological Effect of Roentgen Rays. F. M. Groedel and E. Schneider. Strahlentherapie, 1926, XXIII, 411.*

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**Treatment of uterine conditions.**—This is a rather complete discussion of the indications for the three methods of treatment enumerated, with a consideration of the results to be expected from each.

In the entire absence of symptoms, no treatment whatever is indicated. Radium therapy is indicated for all patients over forty who have fibromyomas less than 15 cms. in diameter, with hemorrhage as the presenting symptom. It is also the treatment of choice in individuals of any age, if surgery is contraindicated by cardiac or other conditions, or if

surgery is refused. It is the treatment in cases of fibrosis uteri or essential uterine hemorrhage.

Surgical treatment is considered indicated for most patients under forty; for most patients with bladder symptoms; in cases where the tumor is larger than 15 cms. in diameter, or where it is pedunculated or submucous, or is degenerating or inflamed, and for those in whom a reasonable suspicion of serious complications in the adnexa exists.

There is an excellent discussion of relative indications for myomectomy, sub-total abdominal hysterectomy, and complete hysterectomy.

C. D. ENFIELD, M.D.

*Myomectomy, Hysterectomy and Radiotherapy in Fibromyoma of Uterus. James C. Masson. Jour. Am. Med. Assn., Nov. 6, 1926, p. 1530.*

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**Temporary roentgen-ray sterilization.**—In this paper the experience of the Seitz clinic (University of Frankfort-on-Main) with temporary roentgen-ray sterilization is related. Of the 200 cases, 25 per cent were chronic inflammations of the adnexa of gonorrheal origin, 40 per cent of non-gonorrheal origin, 6 per cent of tuberculous origin, 15 per cent tuberculosis of the lungs, 5 per cent fibroids in patients from 25 to 35 years old, 5 per cent irregular menstruation caused by ovarian dysfunction, 2 per cent osteomalacia, 1 per cent preclimacteric bleeding, 1 per cent menstrual psychosis. The observed duration of the amenorrhea is divided into two groups; continuous time from the disappearance of the menstruation to the appearance of the first spotting, this then followed again by another period of amenorrhea until finally the regular period reappears. The entire length is called "total effective time." The opinion of Gauss that younger women require a higher dose is verified. From 62 patients detailed information as to the reappearance of the menstruation could be obtained. In 25 cases the same type appeared after the end of the time of the roentgen-ray amenorrhea in an irregular way; in 29 cases the first or second period was followed by amenorrhea in an irregular way, until finally the previous cycle returned; the third group (6 cases) had frequent menses every fourteen days to four weeks before normal conditions were established. In four cases no regularity appeared even after long observation. The majority of women complained of vasomotor disturbances; the libido seemed to be appreciably disturbed in only about 10 per cent. Four cases went through pregnancy; one was treated during the fourth month for fibroid. All children are well so far and appear normal. The clinical results in general were very satisfactory. As long as a definite injury to future pregnancy is not proved, child-bearing age is no contra-indication to temporary sterilization by roentgen rays. On the other hand, this therapy should be resorted to only if everything else fails.

E. A. POHLE, M.D.

*Regarding Temporary Roentgen Amenorrhea. H. Guthmann and Oskar Bott. Strahlentherapie, 1926, XXIII, 488.*

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**Recklinghausen's neurofibromatosis.**—Attention is called to the bone changes previously reported in Recklinghausen's neurofibromatosis. In 1924, seven cases were reported; the present essay adds two more cases. Bone changes in association with this disease are mentioned here and there in the literature, but no attempt is made to classify the lesions with the exception of the common occurrence of scoliosis, by Engman and Weiss. Three types of bone changes were previously described by the authors: (1) scoliosis; (2) abnormalities of growth of individual bones; (3) irregularity of outline of bones, ranging from central and subperiosteal cysts to pedunculated subperiosteal tumors. All of these changes can be explained on the basis of the involvement of bone by the growth of tumor tissue characteristic of Recklinghausen's disease. The two additional cases reported had deformity of the pelvis and ilium, with a pedunculated tumor of the tibia, and involvement of the skull, respectively. Microscopic study in the one case revealed the invasion of

the bone cortex by cellular tissue which was thought to represent neurofibroma. The author pleads for a complete, detailed study of the osseous system in all cases of the disease so that the full significance of these changes may be ultimately determined.

L. R. SANTE, M.D.

*Recklinghausen's Neurofibromatosis and the Skeleton: A Plea for Complete Study of the Disease. Edwin P. Lehman. Archiv. Dermatol. and Syphilol., August, 1926, p. 178.*

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**Roentgen therapy of Mikulicz's disease.**—The patient, a man 56 years old, was operated upon in 1924, for pyloric stenosis (carcinoma?). In April, 1925, he noticed swellings in the palate, over both eyes, the floor of the mouth, gingiva, cheek and neck. In the right epigastric region, a tumor of fist size could be felt; the spleen was definitely enlarged. Biopsy showed unspecific lymphatic tissue. All lesions were treated with one-third to one-fourth S.U.D. (150 K.V., 2½ ma., 23 cm. F.S.D., 3.0 aluminum). Reduction of almost all lesions took place in from one to two weeks. One recurrence was observed during the following year; this yielded promptly to roentgen radiation.

E. A. POHLE, M.D.

*Regarding the Roentgen Therapy of Mikulicz's Disease. J. Ziegler. Strahlentherapie, 1926, XXIII, 528.*

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**Erythema dose in roentgen units with varying effective wave lengths.**—The erythema dose measured on patients using the radiation of lambda effective 0.14 to 0.16 Å has been given by American investigators at 1,200 to 1,400 *R*, while German clinics give an equivalent value (energy measured in air only) of 500 to 600 *R*. To this amount, the scattered radiation from the patient has to be added. Recent investigations have shown that this so-called back scattering is not as high as 100 per cent, but only 36.5 per cent (190 K.V., 1.0 copper plus 1.0 aluminum, 50 cm. distance, 20×20 cm. field). This would reduce the erythema dose for the above-mentioned radiation, based on measurements in air, to 800 *R*. No explanation has been found so far for the discrepancy between American and German erythema doses in roentgen units.

Another question is the influence of the wave length on the ionization in small chambers. It is necessary to establish the erythema dose in roentgen units for either quality of radiation when employing one of the ordinary chambers on the market. The authors have constructed, after numerous experiments, a small ionization chamber which is constant for potentials from 50 K.V. (no filter) to 200 K.V. (1.0 copper filter). It has a bakelite wall approximately 0.6 mm. thick which bears a coat of 97 per cent Acheson graphite and 3 per cent silica. The results of several series of measuring depth doses, back scattering and influence of port of entry are given and discussed. In conclusion, the authors urge the construction and acceptance of one "normal chamber" for measuring purposes to permit the comparison of any dose recorded on the human body.

E. A. POHLE, M.D.

*Regarding a Small Ionization Chamber Measuring Roentgen Units Independent from the Wave Length and the Measurement of Back Scattering in the Water Phantom. R. Glocker and E. Kaupp. Strahlentherapie, 1926, XXIII, 447.*

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**Gall bladders of diabetic patients.**—This paper is based upon some observations resulting from the examination by the tetraiodophenolphthalein method of the gall bladders of 70 diabetic patients encountered in the routine of hospital practice. These 70 cases gave 27 abnormal cholecystograms, 59 per cent in the females and 41 per cent in the males of the series. The conclusion is reached that it will be necessary to have a considerable amount of data, not now available, including histological studies of the gall bladders of diabetic patients, before any conclusion can be reached as to a possible connection between the pancreatitis, so often a concomitant of gall-bladder disease, and diabetes. Attention

is called to the large percentage of these patients showing abnormal cholecystograms in spite of the fact that the series included all the diabetic patients in the hospital during a given period and the cases were not selected with regard to history of previous gastro-intestinal disturbance.

C. D. ENFIELD, M.D.

*Cholecystography in Diabetes Mellitus. M. K. Tedstrom, R. C. Bond, W. H. Olmsted, and Sherwood Moore. Jour. Am. Med. Assn., Nov. 13, 1926, p. 1603.*

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**Cholecystography: direct and indirect methods.**—The author states that the reliability of the findings depends to a great extent on the technic employed. He prefers the intravenous to the oral method. The jejunal and rectal administrations have been discontinued as too irritating and causing too much reaction. The bromide salt caused a circulatory depression, with a drop in blood pressure severe enough to become alarming. The reaction was most noticeable in (1) the oral method; (2) the use of the bromide salt or deteriorated iodine salt; (3) in some patients of neurotic temperament.

Details of the intravenous injection are given, the dye being diluted with 75 to 100 c.c. of warm Ringer's solution: the films are taken about fourteen hours afterward. The patient is then allowed a breakfast of milk, cream and egg yolk, to empty the gall bladder, and in about three hours more films are taken.

The intravenous method has this advantage over the oral, that a definite amount of the dye is injected directly into the blood and there is no dependence on the dissolving of the capsules and incomplete absorption as in the oral method. Therefore, under this condition, failure to obtain a gall-bladder shadow is more significant and may be definitely interpreted.

Shadow interpretation is given, with the description of the normal shadow. Careful comparison of the findings at operation and microscopic and cultural studies confirm the X-ray diagnosis. The interpretation of pathological findings is discussed as well as the mechanism of producing the shadow and conditions interfering with its production.

Gall-bladder studies of the "pre-Graham" period are discussed, with a résumé of diagnostic work done since 1913 by means of the so-called "direct" method. During this period, 40 per cent of gallstones were visible with the X-ray examination, confirmed by Carman at the Mayo Clinic. The various elliptical shadows encountered in the gastro-intestinal examination, involving the duodenum, cap and sometimes the pylorus, cannot be depended upon as representing the presence of pressure from the gall bladder. Rechecking such pressure effects after administration of the dye, showed the location of the gall bladder to be some distance away. There are many illustrations showing such depressions with and without subsequent administration of the dye to outline the position of gall bladder or stones.

TRESSA R. MORAN, M.D.

*The Relative Value of Cholecystography and the So-called Direct and Indirect Methods of Roentgenologic Examination of the Gall Bladder. James T. Case. Am. Jour. Roentgenol. and Rad. Ther., September, 1926, p. 238.*

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**Hodgkin's disease.**—The clinical picture of Hodgkin's disease as well as its etiology, pathology, symptomatology and history is presented in considerable detail. In the author's series of 173 cases, glandular involvement was primarily in the neck in 86 per cent, in the mediastinum in 7.5 per cent and in the abdomen in 6.1 per cent. Sixty-six per cent of the cases occurred between the ages of 20 and 50. The cardinal symptoms are given as tumor masses, fever, weakness, and itching of the skin. Temperature was irregular, conformed to no type, was present in 50 per cent of these patients at the time of initial examination, accompanied by chills in 10 per cent and sometimes went as high as 105°. Weakness was an outstanding symptom and was complained of in 47 per cent. The author considers it a valuable index of the need of further treatment after the glandular masses

have disappeared. Itching may be accompanied by no skin changes, except scratch marks, while in other instances the skin becomes bronzed, thick and dry. There may be eruptions like prurigo or general erythrodermia, with scaling and desquamation. Herpes zoster is an occasional skin manifestation.

Cough and dyspnea are mentioned as sequelæ to the mediastinal gland enlargement, as are also difficulty in swallowing and congestion of the vessels of the head and neck. Various types of indigestion follow involvement of abdominal glands. Enlargement of the liver was rare in this group, while splenic enlargement was very common. The blood picture is not characteristic and is chiefly of negative value in differentiating this disease from the leukemias. A high relative polymorphonuclear count gives an unfavorable prognosis, and *vice versa*. High red counts and hemoglobins are favorable, and *vice versa*. Stress is laid on the fact that length of life and clinical progress are greatly modified by treatment and also by general hygienic conditions.

Surgery other than the removal of an isolated gland for pathological examination is not considered advisable. Of drugs, the arsenic group is held to be of value for its tonic effect, and all others useless. The importance of avoiding infection, particularly influenza, and of taking good food and plenty of rest is emphasized. Possible sources of infection should be cleared up surgically, if necessary.

Most of the cases reported were treated with radium, and the technic was based on the large amount of that agent available to the author. There was no fixed technic, treatments being adapted to conditions obtaining in individual patients. The radium pack is recommended to be placed two inches from the skin, with filtration of 1 mm. of copper and 1 mm. of lead in treatment of superficial glands; and four or five inches from the skin, with similar filtration, for the treatment of deep areas. The dose at two inches is four gram hours and at four or five inches, fifteen to twenty-five gram hours, which the author calculates to be about 50 per cent of an erythema. In the cases where the author has used roentgen ray instead of radium, he has made use of a high voltage technic with water-cooled tube, 240 K.V., 40 ma., 50 cms., with filtration of 1 mm. of copper, 1 of aluminum and 3 cms. of rubber, a technic which gives tanning in 7 minutes.

The author's attitude with regard to the possibility of cure by radiation supported by hygienic measures seems much more optimistic than is the rule with most writers on this subject. In only 11 cases out of the series was there no clinical improvement under treatment; 110 cases have died of the disease, while 28 are listed as clinically cured for periods varying from 1 to 10 years; 13 of the 28 have been well for over 5 years.

In concluding, the author states that "while Hodgkin's disease is a very fatal malady, its treatment from the standpoints of both palliation and cure, is hopeful. In this connection, radium stands in the first place although it is possible that similar results may be obtained by roentgen-ray irradiation."

C. D. Enfield, M.D.

*Hodgkin's Disease, with Especial Reference to its Treatment by Irradiation. Curtis F. Burnam. Jour. Am. Med. Assn., Oct. 30, 1926, p. 1445.*

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**Effect of electromagnetic waves on Traube's cells.**—The authors studied the influence of X-rays, heat, cold, and light upon the permeability of suspension membranes. They chose the membrane which is formed by a crystal of potassium ferricyanid in a copper sulphate solution (Traube cell). They have come to the following conclusions: (1) X-ray in therapeutic doses did not cause any change in Traube's membranes; (2) the normal behavior of these cells is affected in an accelerating way by heat and in an inhibiting manner by cold; (3) visible and ultra-violet rays cause a characteristic change in the membranes; their color is changed from the normal pink into an intense yellowish-green; their formation is inhibited and degeneration seems to take place slower; (4) microscopically, the light membranes show a particular type of crystal formation which suggests an increase of the crystallization points in the light; (5)

the permeability of the membranes changes with their age; they are almost impermeable in the fluid phase, semipermeable when just turned into solid form, and completely permeable when aged; (6) the observed changes under the influence of light are explained by the varying permeability. In some experiments antagonistic effects of rays of various wave lengths could be observed.

E. A. POHLE, M.D.

*Regarding the Effect of Electromagnetic Waves of Various Lengths on Traube's Cells. G. Politzer and F. Scheminzky. Strahlentherapie, 1926, XXIII, 385.*

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**Ionization in therapy.**—The therapeutic effect of radiation cannot be explained solely by absorption taking place in the skin. It seems that the ionized air which is inhaled by the patient during the treatment by a mercury vapor lamp has a definite therapeutic effect. The author has constructed a large chamber in which adults can be treated with a combination of surface radiation and inhalation of the ionized air. The results of experiments on guinea pigs which inhaled ionized air three hours daily after they were inoculated with tubercle bacilli suggest trying this procedure in the treatment of human tuberculosis. Clinical investigations to that effect have been started.

E. A. POHLE, M.D.

*Regarding the Path and Effect of Ionization in Therapy. H. Picard. Strahlentherapie, 1926, XXIII, 541.*

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**Bone cysts.**—This article is based on detailed histories of two cases, including reports of pathological examination of tissues removed at operation, roentgenograms and bacteriological findings from the cyst contents and cyst walls.

The author concludes that it is highly probable that the *Streptococcus viridans,* isolated in both cases from the cyst walls, is the causative organism of this disease. An analogy is drawn from bone changes occurring in chronic peri-apical dental infections which usually develop silently, producing extensive bone absorption without surrounding new bone formation and which have been found by various workers to contain this organism.

C. D. ENFIELD, M.D.

*The Etiology of Solitary Bone Cyst. D. B. Phemister and John E. Gordon. Jour. Am. Med. Assn., Oct. 30, 1926, p. 1429.*

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**Bladder carcinoma.**—This is a report based on 120 cases of bladder tumors classified as: (1) Papillomas, benign and malignant; (2) non-infiltrating papillary carcinomas; (3) infiltrating carcinomas, superficial and deep.

A plea is made for better co-operation between the urologist and the roentgenologist, and for more close attention, especially on the part of the latter, to the purely clinical aspects of the individual case, so that a tendency to routine handling may not prejudice the chances of the patient presenting aspects of the disease slightly out of the ordinary. Attention to the blood picture is particularly necessary. It is rarely safe to treat a patient whose white count has fallen below 4,000. Even though no other benefit is obtained, the root pains and hematuria are almost always relieved.

Superficial papillary carcinoma can usually be handled successfully by intravesical applications of radium, provided too much of the bladder surface is not involved. By a combination of fulguration, radium through the urethra, and cautery through suprapubic incision, about 75 per cent of tumors can be removed. The remaining 25 per cent, either because of their situation or extent, are impossible of removal. However, a few of these cases can be successfully handled by implanting needles of radium through suprapubic incision. The remainder of the 25 per cent, which are unsuitable for fulguration, intravesical radium or operation, form the field for deep roentgen therapy alone. Seventeen of 21 tumors of this class in the author's series were extensive infiltrating papillary carcinomas.

Many of these patients were in such bad condition that only a part of the desired dose of X-ray could be administered. In only two was there marked improvement from the X-ray alone. In two others, improvement was secured by following the X-ray with intravesical radium. It is believed that better results are obtained when the tumor receives radium treatment before the roentgen-ray treatment.

On account of the great tendency to recurrence, it is advisable to examine the bladder through the cystoscope at frequent intervals after apparently successful treatment, in order to detect and treat recurrence as early as possible.

C. D. ENFIELD, M.D.

*Deep Roentgen-ray Therapy in the Treatment of Carcinoma of the Bladder. Charles A. Waters. Jour. Am. Med. Assn., Nov. 13, 1926, p. 1618.*

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**A new tube cylinder.**—A new type of leaded cylinder enclosing the deep therapy tube is described. It can be shifted in the vertical direction with the help of a small electric motor, while rotation around the horizontal axis is possible by hand. The air inside the cylinder is renewed by a fan which is attached to one end. The device offers protection against high tension shock and stray radiation. An automatic safety lock for filters is also provided.

E. A. POHLE, M.D.

*A New High Tension and Ray-proof Treatment Apparatus. H. Holfelder. Strahlentherapie, 1926, XXIII, 532.*

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**Carcinoma of urinary bladder.**—This paper is based on 53 cases of inoperable and advanced primary carcinoma of the urinary bladder treated with radium, cautery and radium and roentgen rays, and roentgen rays alone. Of 21 cases treated with radium applied directly to the growth, 1 has been apparently well for 11 years and 1 for 6 years, while the average duration of life after treatment was 18 months in the primary cases and 8 months in the recurrent cases. Nineteen cases were treated with combined cautery and irradiation. In such of these cases as were treated with roentgen ray, the factors were 140 K.V., ½ mm. of copper and 1 mm. of aluminum filtration, 100 per cent erythema doses over one anterior and one posterior portal. Results in these cases were very bad, the average duration of life in the primary cases being 4 months, and in secondary, 8 months. None of these patients is mentioned as being still living or as having shown at any time clinical cure.

For three and a half years, the authors have used massive short wave roentgen rays exclusively, factors being 211 K.V., 0.75 mm. of copper, 1 mm. of aluminum, 65 cm. focus skin distance, 25 ma., fields 15 × 20 cms., and portals of entry calculated to give 130 to 150 per cent erythema skin dose to the bladder. Thirteen patients were treated prior to April, 1925; 4 of the 7 with primary lesions are well at the time of writing and 3 of the 6 with secondary lesions.

The authors consider these results immensely superior to anything they were able to obtain with either of the other methods of treatment employed and ascribe these results to homogeneous treatment of the entire tumor, absence of local traumatism in connection with the treatment, and inherent sensitiveness to radiation of the cell types composing bladder cancers.

C. D. ENFIELD, M.D.

*Roentgen-ray Treatment of Inoperable Carcinomas of the Urinary Bladder. Henry Schmitz and Joseph E. F. Laibe. Jour. Am. Med. Assn., Nov. 6, 1926, p. 1541.*

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**Use of lipiodol in oviducts.**—Lipiodol is used because of its aseptic and antiseptic properties as well as its great opacity and harmlessness. This is used to recheck the nonpatency of tubes previously subjected to insufflation with carbon dioxide on at least three occasions and found closed. Also, to locate the point of stenosis or stricture as an aid in deciding the advisability of corrective operation.

The technic of introducing is given in detail

and illustrations made from the roentgen films show the location of the lipiodol as well as the peristalsis in the tubes. Films made at intervals of days, weeks and months show the lipiodol at various points in the tubes and in the peritoneal cavity. Caution is emphasized as to the amount of lipiodol to be injected and pressure during introduction.

TRESSA R. MORAN, M.D.

*Uterotubal Roentgenography with Lipiodol. I. C. Rubin and A. J. Bendick. Am. Jour. Roentgenol. and Rad. Ther., September, 1926, p. 251.*

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**Roentgen doses in roentgen units.**—The author has compiled in this paper numerous tables presenting the dose in roentgen units which is required to produce a temporary sterilization of varying duration and also a permanent sterilization. The relation between the quality of radiation and back scattering and influence of the size of the field and focal distance on the ratio between the surface and depth dose are explained.

E. A. POHLE, M.D.

*Regarding Roentgen-ray Doses in the Absolute Measure of the Roentgen Unit. G. H. Schneider. Strahlentherapie, 1926, XXIII, 463.*

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**X-ray tracing of fistulous tract.**—The author reports a review of several cases of lateral cervical fistula, with the X-ray findings. Lateral cervical fistulæ are "well known, frequently discussed, and seldom seen." They develop from the thymic duct, which normally becomes obliterated in the sixth week of fetal life. Lateral cervical fistulæ may be present at birth or they may appear in later life. Anatomically, the fistulous tract usually extends between the following two points: (1) the external, lower orifice situated from 1 to 3 cm. above the sternoclavicular joint, overlapping the anterior border of the sternomastoid muscle, and (2) the internal or pharyngeal orifice, almost invariably situated on the posterior palatine arch, or directly in front of or behind it.

To trace the course of a patent cervical fistula we could begin at the lower external orifice just above the sternoclavicular joint and go inward laterally and upward, to emerge at the pharyngeal orifice on the posterior palatine arch.

By experiment it has been found that Beck's paste is too thick to inject satisfactorily into the entire tract, while a bismuth-oil injection works admirably. After the injection roentgenograms are taken, which show the size, shape and course of the fistulous tract.

B. C. CUSHWAY, M.D.

*Lateral Cervical Fistulæ. Rudolph Kramer. Laryngoscope, July, 1926, p. 517.*

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**Brain abscesses.**—This paper reports two cases, the first of which is, briefly, as follows: Male, age 26 years, white, family history negative. Well until April 5, 1924, when he became ill with a heavy cold; headache severe, could not sleep, went to a hospital, became paralyzed on left side and then delirious, transferred to another hospital and had an operation on skull. An abscess was found in the right parietal region; this was drained. Paralysis cleared up, headache improved. Second operation one month later. Under date of April 5, 1924, a diagnosis of pansinusitis, acutely suppurative had been made. Under date of April 11, 1924, the diagnosis was subdural abscess, localized over the fissure of Rolando, secondary to ethmoidal sinusitis. At time of admission to hospital when first seen by the writer, three and one-half months after onset of condition, patient had improved. Ears were normal; there was a herniation of the intracranial contents through the opening in the right side of the skull. An examination of the nose and sinuses was made. Transillumination and X-ray showed definite evidence of involvement of the maxillary and frontal sinuses on the right side. Patient's condition became rapidly worse, paralysis of the left side came on a second time and herniation of intracranial contents increased. Condition became hopeless and patient died in a few days.

Autopsy revealed an extremely large ab-

scess of the right cerebral hemisphere, which caused a herniation of this structure through the osteoplastically decompressed area. The abscess cavity was filled with thick, greenish-yellow pus. Postmortem diagnosis was chronic, pyogenic abscess of the brain, involving the greater portion of the right cerebral hemisphere. The sinusitis present when this patient came under observation was on the right side, the same side as the brain abscess.

The second case is that of a male, 34 years old, colored, waiter by occupation, family history negative. For five years before present examination he had been having trouble with his eyes, which ached and caused pain. Discharge of thick, foul-smelling pus from right nostril for more than a year. Never had any treatment for eye or nose conditions. Eye examination showed: O. D., L. and S., and A. S., 20/20. Profuse purulent discharge, coming from right naris; foul odor. Transillumination was positive for involvement of right antrum. X-ray examination showed: Frontal sinuses large; no definite involvement; increase in density over right antrum.

Radical maxillary sinusotomy performed August 22. Sinus found filled with pus. Patient improved for a time. On September 16 he had an attack which was at the time considered an epileptic seizure, lasting about one-half hour, after which patient appeared to have improved. September 25 he complained of severe headache and had temperature of 100°. Had another attack, passed into coma, and died less than one hour later.

Postmortem showed: Abscess cavity involving temporal lobe ruptured during removal of brain; surrounding area extremely necrotic; ethmoidal cells also filled with necrotic tissue throughout, with sequestrum of bone. A diagnosis was made of an old brain abscess involving temporal bone, right cerebral hemisphere. The sinusitis, maxillary and ethmoidal, was present on the same side as the brain abscess.

B. C. CUSHWAY, M.D.

*Report of Two Cases of Brain Abscess Present in Patients Suffering from Nasal Accessory Sinus Disease. Robert E. Parrish. Laryngoscope, May, 1926, p. 336.*

**Roentgen therapy of goiter.**—This is a brief review of the development of roentgenotherapy of Basedow's disease and its present technic, indications, and results. The first case ever treated was a patient of the American physician, Williams, in 1902. To-day it may be stated that 80 per cent of all cases are benefited by X-ray treatment and one-third of these are free of symptoms afterwards. The effect seems to be due in all probability to the direct inhibiting action on the secreting cells and is not a secondary result of the injury to the capillaries. The author recommends one-eighth to one-third S.U.D. through 1.0 aluminum, several times, with four- to eight-day intervals. The whole series may be repeated after three to four weeks, not more than four series being given. After four months all unimproved cases are referred to the surgeon unless there is contra-indication to operation. As to the possibility of adhesions after roentgenotherapy, it appears that most surgeons do not think this to be of considerable importance, chiefly in view of the moderate doses used. In conclusion, the author suggests trying X-ray treatment in all cases first, except those where breathing is disturbed by an enlarged thyroid.

E. A. POHLE, M.D.

*The Present Status of Roentgenotherapy of Basedow's Disease. J. Borak. Strahlentherapie, 1926, XXIII, 519.*

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**Vitamins in rickets therapy.**—Recent investigations of the anti-rachitic substances are discussed. The process taking place in milk when subjected to ultra-violet radiation is called "Jekorisation," which means that it possesses rachitic healing proporties. If one considers that the photo effect of substances after exposure to ultra-violet rays has been found to be due to the formation of active oxygen, it seems that the therapeutic action of ultra-violet rays is largely due to the liberated active oxygen. Hyperemia in the skin plays only a secondary rôle; it assists in the transportation of the products formed under the influence

of the oxygen. The authors suggest, further, to regard active oxygen as a vitamin.

E. A. POHLE, M.D.

*The Vitamin Problem in the Therapy of Rickets. F. Kohl, H. Geffcken and H. Richter. Strahlentherapie, 1926, XXIII, 706.*

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**Tuberculosis of the female generative organs.**—After a discussion of the clinical problems involved in tuberculosis of the female generative organs and the peritoneum, the author presents his results obtained by roentgen-ray therapy in 44 cases belonging to this group. Laparotomy is done only in cases with exudate in the abdomen; this exudate is drained, then tissue for biopsy taken and the wound closed. If inspection of tubes, ovaries and uterus reveals far advanced pathology, complete hysterectomy is carried out. In young women, some ovarian tissue should be left behind to avoid castration; for the same reason, the following roentgenotherapy must not reach the sterilization dose. Cases with extensive intestinal adhesions are not touched, but closed up immediately. All extreme pelvic inflammatory processes with considerable pus formation are drained through the vagina and then irradiated. Deep therapy technic is used: 160 to 200 K.V., 0.5 to 1.0 Cu., 30 to 60 per cent S. U. D. to the lesion. One ovary must be carefully protected. A general therapy supplements the local treatment, to build up the resistance of the body. Ultra-violet radiation seems to be very valuable. Of the 44 cases, 22(19) were cured, 9(7) improved, 8 lost from sight, 5(1) died. (Figures in parentheses represent the cases with histological diagnosis.) One patient's death was thought to be due to the irradiation.

E. A. POHLE, M.D.

*Regarding Genital and Peritoneal Tuberculosis of the Female. O. Gragert. Strahlentherapie, 1926, XXIII, 594.*

**Development of malignancy after roentgen-ray sterilization.**—Ever since the introduction of radiation for sterilization in the treatment of uterine fibroid or other non-malignant conditions, the question of the later development of a malignant tumor in the generative organs has been discussed. The possibility of such a complication has induced a number of surgeons to prefer hysterectomy to radiotherapy. In this paper the author relates the experience of his own clinic and reviews the published literature dealing with this problem. He has seen three cases of carcinoma of the fundus, one case of sarcoma of the pelvis and upper thigh, and one hyaline degeneration of uterine fibroid after roentgen sterilization. Six non-malignant tumors of the ovary after irradiation have been observed so far, also seven cases of carcinoma and two cases of sarcoma. The total number of cases of uterine carcinoma has been increased in the meantime to thirty, in addition to seven cases of sarcoma. He does not recommend radiation therapy of sarcoma of the uterus or ovaries, as do Seitz and Wintz, but operates on all cases, including inoperable tumors, followed by post-operative roentgenotherapy. If diabetes complicates this condition, radiation therapy seems to be a failure. Strict indication for roentgen-ray treatment of non-malignant conditions of the female generative organs is essential. A curettage and histological diagnosis should be done as a routine before any treatment. If a fibroid does not respond to the second series of treatments, operation should have the preference. Any woman bleeding after the fifty-fifth year is to be considered as a case of malignancy. A critical review of all cases of malignant and non-malignant tumors occurring after irradiation does not reveal any evidence of a causal relation between treatment and tumor. We have, therefore, no reason to give up radiation therapy of non-malignant conditions of uterus or ovary.

E. A. POHLE, M.D.

*Further Contributions to the Question of Tumor Formation after Roentgen-ray Sterili-*

*zation; Special Consideration of the Development of Sarcoma in Ovary and Uterus. E. Vogt. Strahlentherapie, 1926, XXIII, 639.*

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**Accuracy of methods.**—Dr. Morrison reports briefly five cases, in four of which able roentgenologists had given negative reports of foreign bodies in the eye. He states that in these cases the reflection is not upon the roentgenologist but upon the method of examination. In four of the cases foreign bodies opaque to X-rays were found and removed, after negative reports from the roentgenologist. A positive report of a foreign body in the vitreous was found, after enucleation of the eye, to be due to clotted blood in the vitreous body.

Dr. A. E. Bulson, Jr., Editor of the *Journal of the Indiana State Medical Association*, comments on the report in an editorial, and states that it seems to prove that reports of roentgenologists are subject to considerable variation as to accuracy and trustworthiness. He also reports a case reported negative by a roentgenologist, after taking a dozen or so films; subsequently the eye became inflamed and the patient was sent to another roentgenologist, who reported a foreign body in the eye ball. The eye was enucleated and a piece of steel was found in the location described by the second roentgenologist. The Editor states that special attention must be paid to the kind of apparatus used, the training and experience of the operator, and the care with which interpretation of the film is made. He raises the question as to what sort of complication would have occurred had the case become a legal one.

The editorial concludes as follows: "We have the highest regard for and receive an abundance of help from the work of the educated and well-trained roentgenologist. His interpretation so often has tallied with the clinical findings that he is a valuable assistant in helping us to arrive at trustworthy conclusions. On the other hand, we frequently have been led astray, often against our better judgment, by the glib reports and findings of the inexperienced and ill-trained roentgenologist, so that we have come to the conclusion that roentgenology, if it is to be valuable to the practitioner of medicine, and especially to the surgeon, must be in the hands of the well-trained roentgenologist."

C. H. DeWitt, M.D.

*Failure of X-ray to Detect Foreign Bodies in the Eye. Frank A. Morrison. Jour. Indiana St. Med. Assn., Nov. 15, 1926, p. 453.*

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**Effect of ultra-violet rays on erythrocytes.**—The author has studied the effect of ultra-violet rays emitted by a quartz mercury vapor lamp on the human red blood corpuscles *in vivo* and *in vitro*. He comes to the conclusion that the membrane of the blood corpuscle is injured, thus leading to hemolysis. It seems that the fat component of the membrane undergoes a change which is probably due to oxidation. Acid is formed during this process and this acid causes a coagulation of the albumin and a brown discoloration of the hemoglobin; hemolysis continues even after the radiation has been turned off. The same change as shown *in vitro* can be demonstrated *in vivo* in the blood stream. The resistance of the blood corpuscles is decreased immediately after the treatment but increased during a series of exposures. Certain catalytic changes may also take place under the influence of ultra-violet rays. Irradiation of several kinds of oil demonstrates the same effect, namely, oxidation, formation of acids, and a catalytic process.

E. A. Pohle, M.D.

*Mechanism of Effect of Ultra-violet Rays on Red Blood Corpuscles. Hans Koeppe. Strahlentherapie, 1926, XXIII, 671.*

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**Roentgenotherapy combined with intravenous injection of dextrose.**—The author reports in this article the histories of 84 tumor cases which were treated with radiation and intravenous injection of dextrose (33 per cent Osmon solution). He has the impression that a higher percentage of malignancies respond to this combined therapy. It also seems that

less total roentgen energy is required. (See RADIOLOGY, July, 1926, VII, 14.)

E. A. POHLE, M.D.

*Combination of Roentgen Radiation and Intravenous Dextrose Injection. E. G. Mayer. Strahlentherapie, 1926, XXIII, 604.*

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**Therapy for exophthalmic goiter.**—This disease should be treated symptomatically since etiologic knowledge is indefinite. All focal infections should be treated. Rest is most important. Chief efforts should be directed toward reducing the vascularity or destroying newly formed cells in the thyroid, which produce altered secretion chiefly responsible for the symptoms. This maybe accomplished by surgery or radiation.

Radiation produces an obliterative endarteritis of the arterioles and diminishes the caliber of the larger ones. Radiation possesses the ability to destroy new cells and diseased cells without killing normal cells, hence, properly used, it should cure the pathology without sacrificing the normal glandular elements. It can be used on inoperable cases, and on cases where operation has not been successful, as well as on cases suitable for surgery.

If four X-ray treatments have been given at 21-day intervals without improvement, radiation should be abandoned and the case may be operated on without any difficulty due to the previous radiation.

What does radiation therapy offer in exophthalmic goiter?

1. No X-ray mortality.
2. No operative scar or hospitalization.
3. Painless and convenient treatment for the patient.
4. Less interference than surgery with the patient's occupation.
5. The thymus and lymphoid hyperplasia may be radiated.
6. A selective action of radiation on abnormal cells without destruction of normal cells.
7. It may be used in inoperable cases.
8. If surgery be necessary, it can be performed with less danger, due to previous thymus radiation.

Neither surgery nor radiation is a specific. Surgeons have operated on cases that were radiated and radiologists have successfully treated operative non-successes.

In conclusion: What should be the attitude of the general practitioner in referring a case of exophthalmic goiter? If he decides for operation he takes less chance if he refers the case to a surgeon especially competent and trained to handle such cases. If he decides for radiation treatment he should be equally careful to secure a competent radiologist. It is essential to keep two things in mind: first, there is no mortality in radiation treatment, and second, the end-results are practically the same as in the surgical treatment.

C. H. DEWITT, M.D.

*Radiation Treatment of Exophthalmic Goiter. Harold Swanberg. Ill. Med. Jour., Nov., 1926, p. 418.*

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